NOTICE TO READER: When you finish reading this magazine place a 1 cent stamp on this notice, hand same to any postal employee and it will be placed in the hands of our soldiers or sailors at the front. *No wrapping—no address.*—A. S. BURLESON, Postmaster-General.

JAN. 15 CENTS

Electrical Experimenter

OVER 175 ILLUST.

POPULAR ELECTRICAL NEWS ILLUSTRATED

ELECTRO-MAGNETIC DEPTH-BOMBS

SEE PAGE 594

LARGEST CIRCULATION OF ANY ELECTRICAL PUBLICATION

MEN WANTED AS CERTIFICATED ELECTRICIANS

This is the Electrical Age, and this wonderful new profession is calling you. The demand for expert Electricians is greater every year and the salaries higher. Electricity is truly the greatest motive power in the world, to-day, and now is the time to enter this profession.

YOU CAN DO THIS

AFTER HOME STUDY

$36.00 TO $100.00 A WEEK

You can earn $36 to $100 a week and more as an Expert Electrician. If you have a common school education I can train you in a few months at home. Big lighting and power companies, municipalities, and manufacturers are always seeking trained men to handle their Electrical problems.

I Guarantee Satisfaction

Every student receives our Sealed Guarantee Bond, which guarantees to return every penny of his money if he is not entirely satisfied. No other school has made this wonderful offer, but I know the success I have brought to hundreds of my students, and I know what I can do for any ambitious young man who will give me a little of his spare time each day.

FREE ELECTRICAL OUTFIT

For the next 30 days I am giving each student an Outfit of Electrical Testing Instruments, Tools, Electrical materials, and Motor absolutely Free. My instruction is by practical methods and this outfit is used in working out the lessons. Practical training with the theory makes perfect. I am Chief Engineer of the Chicago Engineering Works, and I can give you the training that will land the big jobs and hold them.

If you are in real earnest I want to send you my new Book—"How to Become an Electrical Expert." It's free. No matter how many other schools you write to I want you to have my book—It's different because it's practical—Write today.

CHIEF ENGINEER COOKE

CHICAGO ENGINEERING WORKS

Dept. 21 :: 441 CASS STREET, CHICAGO, ILL.

MAIL THIS COUPON

Dept. 21,
CHIEF ENGINEER, Chicago Engineering Works,
441 Cass St., Chicago, Illinois.

Without obligation on my part kindly send at once, fully prepaid, particulars of your complete Practical Home Study Course in Electricity.

Name .....

Address .....

Town ..... State.....

OUR COUNTRY WANTS MORE CHEMISTS

Here is your opportunity to learn about the wonderful science of chemistry. Chemcraft gives you the most fun, the most experiments and the most real knowledge. Chemcraft service and a subscription to the Chemcraft Chemist are free to Chemcraft owners.

CHEMCRAFT No. 1 **Price Delivered $1.25**
West of the Mississippi and Canada $1.50

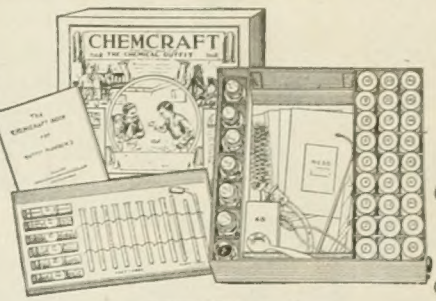
This is a dandy set at a very reasonable price. With it you can work lots of wonderful experiments each one of which can be repeated many times. There are 14 different Chemicals, test tubes, glass tube, measures, etc., together with the No. 1 Chemcraft book which gives complete directions, explains all the experiments in a clear, interesting manner, and tells many wonderful and interesting things about Chemistry.

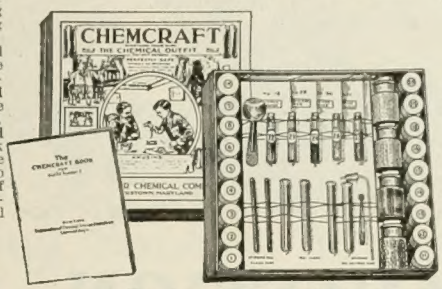
With Chemcraft No. 1 you can make fire ink and fuses; you can bleach colors, test water, prepare chlorine, manufacture ammonia, gun powder, colored fires, black and colored inks; you can prepare magic inks and papers, change water into wine and wine into water, pour ink and milk from same vessel and do no end of other wonderful things.

CHEMCRAFT No. 2
Price Delivered $2.50
West of the Mississippi and Canada $3.00

Chemcraft No. 2 is much larger than the No. 1 set. It contains 32 different Chemicals and a liberal assortment of Apparatus and equipment. There are many rare and valuable Chemicals included in this outfit which represents the biggest value ever put on market for such a low price. The instruction book which comes with this set gives directions for working nearly a hundred wonderful experiments and after you have used the set for a little while you will be able to devise countless additional experiments of your own.

Every purchaser of Chemcraft No. 2 receives a Chemcraft service card, and is entitled to a free subscription to the Chemcraft Chemist. This is the biggest kind of a help in carrying on your experimenting and no one should overlook this offer.





CHEMCRAFT No. 3
Price Delivered $5.00
West of the Mississippi and Canada $6.00

The No. 3 Chemcraft is the biggest and most complete Chemical set on the market. This set contains 48 different Chemicals all of which are carefully chosen because of their many interesting reactions. A large assortment of valuable apparatus is included, among which is a blowpipe, alcohol lamp, 8 test tubes, test tube holder, test tube brush, measures, measuring spoon, gas delivery tube and stopper, glass tube, stirring rod, and other miscellaneous equipment.

The Chemcraft book for outfit No. 3 is complete in every detail. It contains 230 experiments and gives the user a complete course in Chemistry in addition to furnishing all kinds of fun.

Every owner of the No. 3 Chemcraft set is also entitled to Chemcraft service and a free subscription to the Chemcraft Chemist.

Your local dealer probably has the Chemcraft outfits in stock. In case he hasn't, however, we will supply you direct upon receipt of price. Prompt delivery guaranteed.

CHEMICALS AND CHEMICAL APPARATUS

Do you have a chemical laboratory? No experimenter should be without one. A knowledge of Chemistry will always be of greatest value to you and there is nothing more interesting than chemical experiments.

We are specially equipped to meet the requirements of the experimenter for chemical supplies. Let us know your wants. Our catalog lists nearly 200 chemicals, all kinds of apparatus, many books on chemistry, and gives valuable tables and other information. Sent to any address upon receipt of 10c in U. S. stamps or coin.

THE PORTER CHEMICAL CO. Dept. B. Hagerstown, Md.

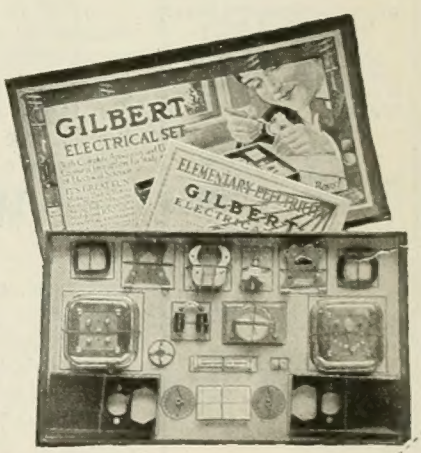
Hello Boys! "You Can't Beat This for Fun"

REG U.S.PAT OFF

"Bill and I don't know what dull times are since we got our Gilbert Electrical Sets. Talk about fun—especially on rainy days when we can't go out! Up into Bill's attic we go and get our

GILBERT

ELECTRICAL SETS



We rig up electric door bells and electric lights, turn on the switch that makes the bells clang and the electric lights flash, make our own motor that generates electricity, make magnets that pick up things, and do lots of other interesting and mystifying experiments."

Boys, tell your parents to get you a Gilbert Electrical Set for Christmas. You'll vote it the greatest toy you ever owned. And while you are having fun with it, you will be learning lots about electricity. Who knows but that through playing with this great electrical set you may make electricity your life work, and develop into a world-famous electrician and scientist like Edison, Marconi or Tesla.

With the Gilbert Electrical Sets you get a beautifully printed manual which tells you many of electricity's wonderful secrets and shows you how to do lots of electrical experiments.

If you own a Gilbert Electrical Set, boys, you can secure free membership in the famous Gilbert Engineering Institute for Boys, and win handsome Degrees, Diplomas, Gold Watches, Gold Fraternity Pins, etc.

Ask your dealer to show you one of these sets today. Price $1.00, $2.50, $5.00, $10.00 (Canada $1.50, $3.75, $7.50, $15.00).

Mail back the coupon today for my boys' magazine "Gilbert Toy Tips" which tells all about the Institute and my other toys for boys.

THE A. C. GILBERT COMPANY A. C. Gilbert Pres.

160 Blatchley Avenue **New Haven, Conn.**

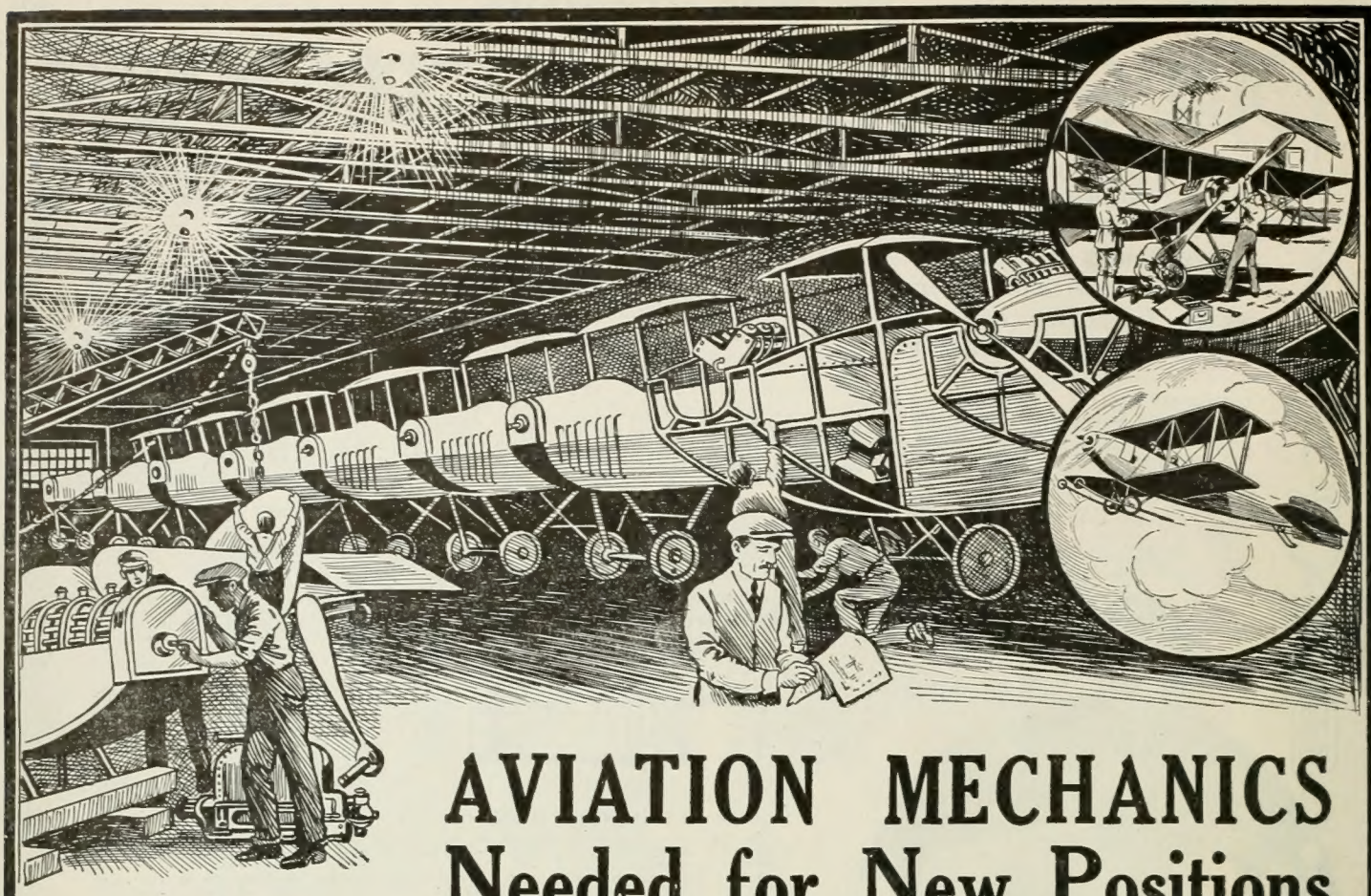
CANADIAN REPRESENTATIVES: Menzies & Co., Limited, Toronto, Ont.

Mr. A. C. Gilbert, Pres.,
THE A. C. GILBERT CO.,
160 Blatchley Av.,
New Haven, Conn.

Please send me a free copy of "Gilbert Toy Tips" which tells all about the "Gilbert Engineering Institute for Boys."

Name .....
Street .....
City .....
State .....

LIBRARY SEP 2 8 1999 UNIVERSITY OF TORONTO



AVIATION MECHANICS Needed for New Positions

Thousands of splendid new positions now opening up everywhere in this amazing new field. New Airplane factories being built—automobile and other plants in all parts of the country being converted to turn out vast fleets of Airplanes for our armies in Europe. And only a few hundred expert Airplane Mechanics available, although thousands are needed. And this is only the beginning. Already airplane mail routes are being planned for after the war and thousands upon thousands of flying machines will be wanted for express and passenger carrying service.

Not in a hundred years has any field of endeavor held out such wonderful chances to young men as are offered to you today in the Aviation Industry. Resolve now to change your poorly paid job for a big paying position with a brilliant future. Send the coupon today for Special limited offer in Practical Aeronautics and the Science of Aviation and prepare yourself in a few short months to double or treble your present salary.

Earn $50 to $300 per week as

Aeronautical Instructor
$60 to $150 per week
Aeronautical Engineer
$100 to $300 per week
Aeronautical Contractor
Enormous profits
Aeroplane Repairman
$60 to $75 per week
Aeroplane Mechanician
$40 to $60 per week
Aeroplane Inspector
$50 to $75 per week
Aeroplane Salesman
$5000 per year and up
Aeroplane Assembler
$40 to $65 per week
Aeroplane Builder
$75 to $200 per week

What Our Students Say:

Mr. Stanfield Fries
Fort Bliss, Tex.
My estimation of the new course is excellent; it could positively not be any better.

Mr. Z. Purdy
Shreveport, La.
It is hard to believe that lessons on such a subject could be gotten up in such an interesting manner.

Mr. Lloyd Royer
Haigler, Neb.
I can hardly thank you enough for the way you have personally taken up my enrollment.

Mr. Mayne Eble
Manistee, Mich.
I believe I learn more from my lessons than an aviator who takes his first lesson with an airman in an aeroplane.

We Teach You By Mail

IN YOUR SPARE TIME AT HOME

Our new, scientific Course has the endorsement of airplane manufacturers, aeronautical experts, aviators and leading aero clubs. Every Lesson, Lecture, Blue-Print and Bulletin is self-explanatory. You can't fail to learn. No book study. No schooling required. Lessons are written in non-technical, easy-to-understand language. You'll not have the slightest difficulty in mastering them. The Course is absolutely authoritative and right down to the minute in every respect. Covers the entire field of Practical Aeronautics and Science of Aviation in a thorough practical manner. Under our expert direction, you get just the kind of practical training you must have in order to succeed in this wonderful industry.

Special Offer NOW!

SEND THIS COUPON TODAY

It is our duty to help in every possible way to supply the urgent need for graduates of this great school. We have facilities for teaching a few more students, and to secure them quickly we are making a remarkable Special Offer which will be withdrawn without notice. Write today—or send the coupon—for full particulars. Don't risk delay. Do it now.

AMERICAN SCHOOL OF AVIATION

431 S. Dearborn Street **Dept. 7441** **CHICAGO, ILL.**

American School of Aviation
431 S. Dearborn Street
Dept. 7441
Chicago, Illinois

Without any obligations on my part, you may send me full particulars of your course in Practical Aeronautics and your Special LIMITED Offer.

Name.....

Address.....

.....

Electrical Experimenter

233 FULTON STREET, NEW YORK

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer;) 233 Fulton Street, New York

Vol. V Whole No. 57 JANUARY, 1918 No. 9

ELECTRO-MAGNETIC DEPTH BOMBS DESTROY SUBMARINES ..... Front Cover
From a Painting by George Wall
ARE THE "HUNS" USING ELECTRIC RAIDERS? By H. Winfield Secor 589
FOG WARNING BY RADIOPHONE.....By George Holmes 591
GROUND TELEGRAPHY IN WAR.....By H. Gernsback 592
HOW AURORA BOREALIS AFFECTS TELEGRAPH AND CABLE LINES 593
THE ELECTRO-MAGNETIC DEPTH BOMB—TERROR OF THE "SUBS" 594
ELECTRIC BUOYS TO MARK TORPEDOED SHIPS, By E. T. Jones, U.S.N. 595
TRAINING U. S. AVIATORS WITH ELECTRIC MAP..... 596
LIBERTY LOAN ELECTRIC SIGNS..... 597
BRONZE TABLET TO MARK FIRST EDISON STATION IN NEW YORK 598
THE X-RAY ON THE BATTLE-FRONT..... 599
HOW A GERMAN TELEPHONE OUTPOST LOOKS..... 600
"TERATUTER"—AN ELECTRICALLY OPERATED FLYING TEACHER 601
MODERN PHYSICS AND THE ELECTRON. THE WORK OF PROF. MILLIKAN 602
NOVEL APPLICATIONS OF THE DICTOGRAPH..... 605
THE CHEMICAL EXHIBITION AT NEW YORK, By Albert W. Wilsdon 608
WAR ADDRESS BY A. I. E. E. PRESIDENT-ELECT E. W. RICE, JR. 609
"TOO LATE"—THE STORY OF A SUCCESSFUL RELAY THAT WAS UNSUCCESSFUL.....By Charles S. Wolfe 610
"ELECTRICIAN-RADIO, U. S. N."—THE WORK OF THE NAVAL RADIO SCHOOL, By Willard Connely, Chief Yeoman, U. S. N. R. F. 612
FRENCH AEROPLANE RADIO GREAT AID TO ARTILLERY.... 614
A SHORT-CUT TO CODE-LEARNING.....By Thomas Reed 615
"HAM" AERIALS.....By W. J. Howell 616
A MECHANICAL INDUCTANCE CHANGER, By Frederick J. Schlink 617
TESTING OF DYNAMOS AND MOTORS.....By Samuel Cohen 619
EXPERIMENTAL MECHANICS. LESSON I....By Samuel Cohen 620
A NEW TYPE OF CHROMIC ACID BATTERY..By C. A. Oldroyd 622
THE ULTRA-MICROSCOPE AND THE UNDERWORLD OF INFINITESIMAL SMALL.....By Frank M. Gentry 623
HOW-TO-MAKE-IT DEPT.—PRIZE CONTEST..... 624
WRINKLES, RECIPES AND FORMULAS..Edited by S. Gernsback 625
EXPERIMENTAL CHEMISTRY—20th Lesson, By Albert W. Wilsdon 626
"ELECTRICAL LABORATORY"—Prize Contest..... 627
LATEST PATENTS DIGEST 628
PHONEY PATENTS—CONTEST 629
QUESTION BOX 630

Raising Sunken Treasures

EVER since the Phoenicians set sail upon the Mediterranean, man's imagination has been stirred profoundly at the idea of recovering priceless cargoes resting at the bottom of the ocean. Whether it is Captain Kidd's fabled treasure or the real $10,000,000 gold treasure sunk at Vigo in 1702 and now peacefully resting, not far from the Spanish coast, makes little difference. All of us nurse a secret desire, that somehow, some day we will be in a position to raise one of the many sunken treasures. If ever mankind was interested in salvaging the cargoes of sunken vessels, the first few years after the present World War is over, will surely eclipse anything of the kind ever imagined before. Billions of dollars worth of priceless cargoes now stud the bottom of the oceans, and while many of the torpedoed ships contain perishable cargoes, not worth raising, there are just as many ships and perhaps a great many more that contain valuable cargoes of metals, coal, ore, etc., which are not at all affected by a prolonged stay in salt water. These ships then are worth while raising—if they can be located—in order to salvage their treasures.

Several companies have already been formed in this country (and we understand in Germany too) whose sole business it will be to sail the high seas in quest of sunken treasures, immediately after peace is declared.

Now comes an interesting point: The oceans, beyond the three mile limit belongs to no nation. By ancient custom a ship sunk in the open sea belongs to whoever salvages it. Neither the original owner, nor the insurance company who paid for the loss, has any claim on the sunken ship. Will this ancient custom prevail after the present war? We much doubt it. Great Britain, the greatest loser of ships and treasure during the war, may be counted upon to propose a new international law, whereby the sunken ship no matter where lost, will revert to the original owners, after the latter have paid a premium for the expenses incidental to salvaging the hull. The British at the end of the war will have several billions worth of treasure on the bottom of the ocean. We may be sure that they will make a Herculean effort to salvage whatever cargo can be raised economically.

Now the curious part about this is that the very submarine which was the direct cause that occasioned the loss of all these ships, will prove to be the one—and perhaps the only one—instrumentality to salvage these same ships.

Already we can picture in our mind's eye flotillas of specially constructed submarines, which will roam thru the inky depths of the seven seas. For there is no technical difficulty today to build a submarine capable of withstanding the tremendous water pressure even at a depth of one thousand feet. And it is safe to say that the majority of ships rest at a considerably lesser level. But how to find the sunken ships? That is the question. Nevertheless the problem is not half as difficult as it may appear at first. Science progresses fast, and it has a trick of making today's impossible, tomorrow's commonplace.

A deep-sea submarine equipt with very powerful searchlights can exploit the bottom of the ocean without any trouble whatsoever. Each such submarine exploits a certain square of territory and it will be but a few weeks till every such area is charted. Undersea growth or sea mud or drift sand will not be much of an obstacle, even if a ship is totally hidden from view. For the exploring submarines will be equipt with sensitive electric Hughes Balances, which indicate at once the presence of metal masses. Incidentally such electric explorations will surely be the direct means of discovering sub-oceanic ore deposits which in the near future will certainly be exploited by sinking down caissons over the under-water mine. A similar method by the way, is already in use near the coast of California where oil is taken out of sub-aquatic oil-wells.

Once the wrecking submarine has located the sunken ship, it is a comparatively simple matter to raise it. Great steel tanks are sunk about the ship, which are then made fast to the latter by well-known methods. A wrecking steamer from above now forces comprest air into the tanks which blow out the water in the latter. Providing we have sufficient tanks, the resultant buoyancy will raise any ship to the surface of the ocean, after which it is towed to the nearest port.

H. GERNSBACK.

The **ELECTRICAL EXPERIMENTER** is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $1.50 a year in U. S. and possessions. Canada and foreign countries, $2.00 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 15 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. **A green wrapper indicates expiration. No copies sent after expiration.**

All communications and contributions to this journal should be address to: Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

ELECTRICAL EXPERIMENTER. Monthly. Entered as second-class matter at the New York Post Office, under Act of Congress of March 3, 1879. Title registered U. S. Patent Office. Copyright, 1917, by E. P. Co., Inc., New York. **The contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris.

HERE YOU LEARN BY DOING

The Only Way to Learn Electricity

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing*. That is the method of the New York Electrical School.

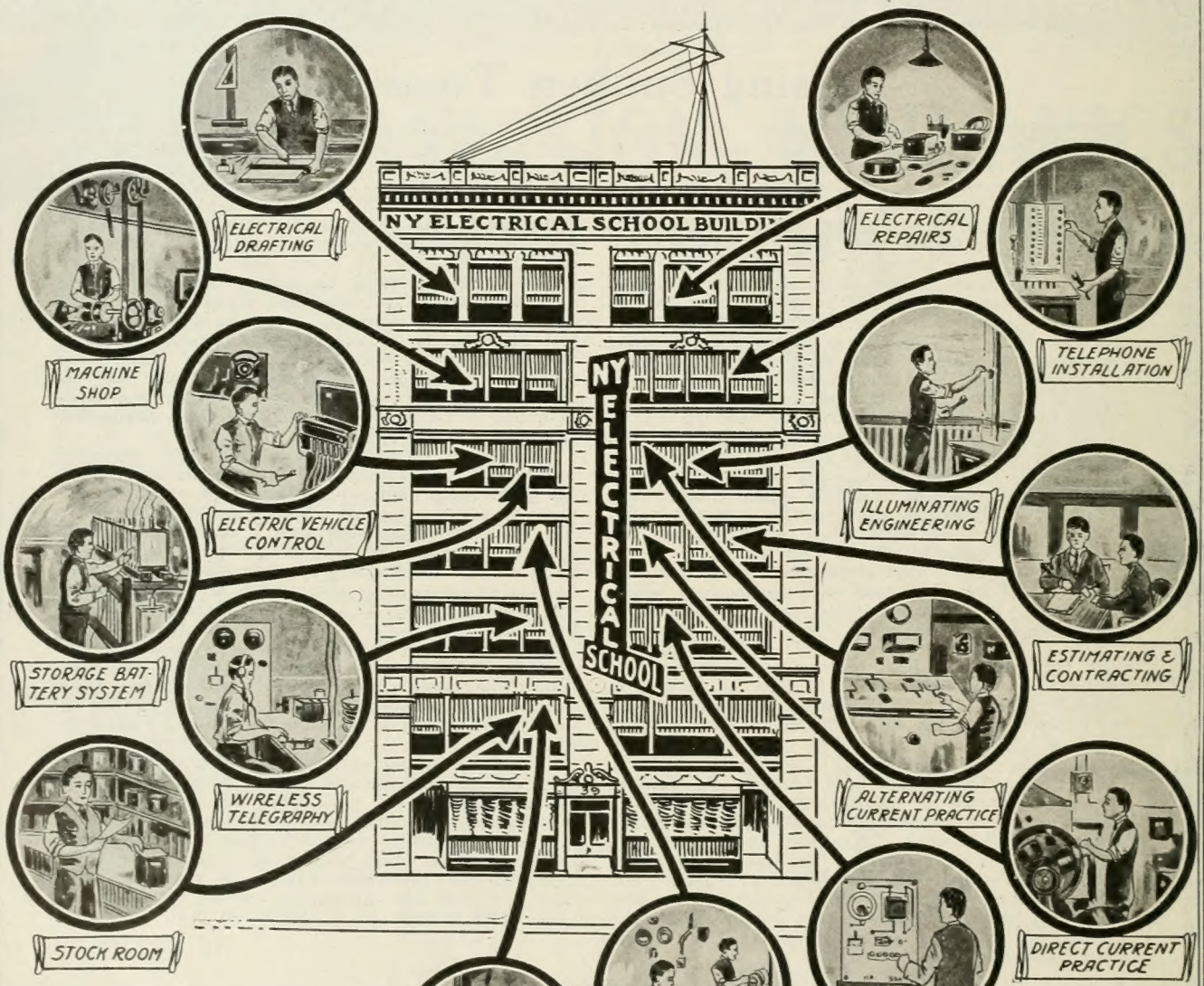
Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

At this "Learn by Doing" School a man acquires the art of Electrical Drafting; the best business method and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.

And Now

If you have an ambition to make a name for yourself in the electrical field you will want to join the New York Electrical School. It will be an advantage to you to start at once. Hurry and send for our 64-page book which tells you all about the school, with pictures of our equipment and students at work, and a full description of the course. You need not hesitate to send for this book. It is FREE to everyone interested in electricity. It will not obligate you to send for it. Send the coupon or write us a letter. But write us *now* while you are thinking about the subject of electricity.

School open to visitors 9 A. M. to 9 P. M.



New York Electrical School
29 W. 17th St., New York, N. Y.

Please send FREE and without obligation to me your 64-page book.

Name .....

Address .....

NEW YORK ELECTRICAL SCHOOL
29 W. 17TH ST
NEW YORK, N. Y.

ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. V. Whole No. 57 January, 1918 Number 9

Are the "Huns" Using Electric Raiders?

By H. WINFIELD SECOR

IT is stated in recent press reports, one of which professes to be an English Admiralty statement, that the Germans have put into commission a remarkable new war-vessel controlled from shore by means of an electric cable attached to the boat, and which craft is *crew-less.*

The report in question further says that —"the electrically controlled motor boats used on the Belgian Coast are twin petrol engine vessels, partly closed in, and travel at a high rate of speed. They carry a drum with between *thirty* and *fifty miles* of insulated single core cable, thru which the boat is controlled electrically. The forepart carries a considerable charge of high explosive, probably from 300 to 500 pounds in weight.

"The method of operating is to start the engine, after which the crew leave the boat. A seaplane, protected by a strong fighting patrol, then accompanies the vessel at a distance of from three to five miles and signals to the shore operator of the helm. These signals need only be 'Starboard,' 'Port' or 'Steady.' The boat is zigzagged while being steered into a ship and the charge explodes automatically.

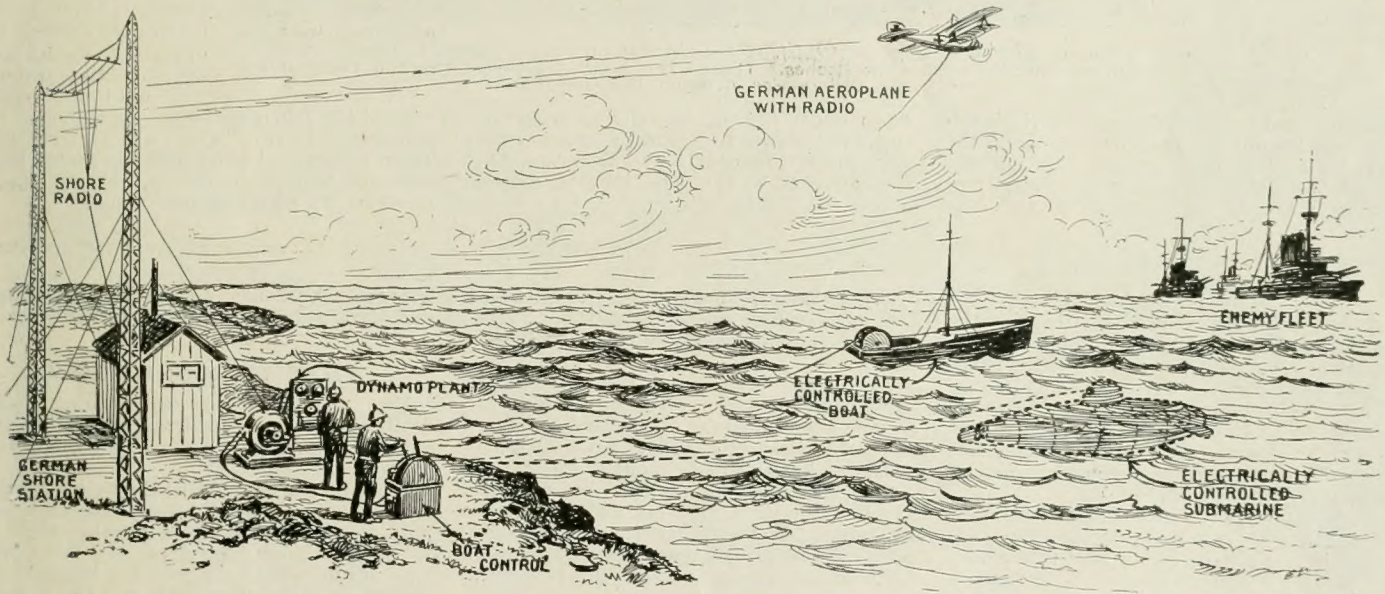
"The device is a very old one. A boat quite similarly controlled was the H. M. S. *Vernon,* a torpedo experimental ship, as far back as 1885. The only new features in the German boat are the petrol engines and wireless signals, neither of which existed then."

So much for the press descriptions. But is such a craft practical? How is it possible to maneuver such a strange acting vessel; for strange it certainly would be, for *hailing* signals could not be answered with no crew on board; without the enemy vessels opening fire and destroying it? Again, is it possible for such an engine of war to be made with a range of 50 miles—or even 10 miles? After considering the above and numerous other questions, it seems that it would be quite possible and, under certain favorable conditions, distinctly practical, for the following reasons:

In the first place, it seems rather problematical whether or not the "electric raider" could approach the enemy vessels close enough to do any serious damage, when the weather is clear. This seeming disadvantage might be overcome, however, by the utilization of reserve engine power on the "raider" when she had approached her target, permitting her to descend on the ship at a speed of 40 to 50 miles per hour. By suitably disposing the magazine containing the 500 pounds of high explosive in a compartment well below the water-line, it would appear to be possible for the "raider" to undergo quite a little shelling without being blown up, and if such was the case, the "raider" might eventually reach her objective.

However, there is another very promising side to the question. Low visibility—in other words, foggy or partly foggy weather. Here is where the "electric raider" shines. The seaplane would, of course, be the all-important means whereby, the raider could be maneuvered in any case. With foggy weather to help, the location and movements of the craft could at all times be ascertained by attaching a kite to it, which the aviator could see above the fog layer, or a light, extra high mast could be provided. In this way, and by other means, such as by arranging a radio transmitter on the raider, it would be quite practical indeed to operate such a boat.

Another interesting problem concerns the 50 miles of cable, which is presumably carried on a reel on the boat, the cable being anchored on shore and properly connected up to the necessary control instruments. Here also is a radio station to receive the instructions sent by the seaplane watching the progress of the "raider." With regard to the great length of cable mentioned, this



It Is Reported That the Germans Recently Sprung a Surprise on the Allied Fleet Off the Belgian Coast in the Form of An Electrically Controlled "Man-less" Boat, Loaded With High Explosives. The Idea Seems Feasible—and Why Not Use a Submarine in the Same Way? The Seaplane Reports the Boat's Movements Back to Shore Where the Control Apparatus Connects With a Cable Joined to the Boat.

Artillery Telephone Service on British Front

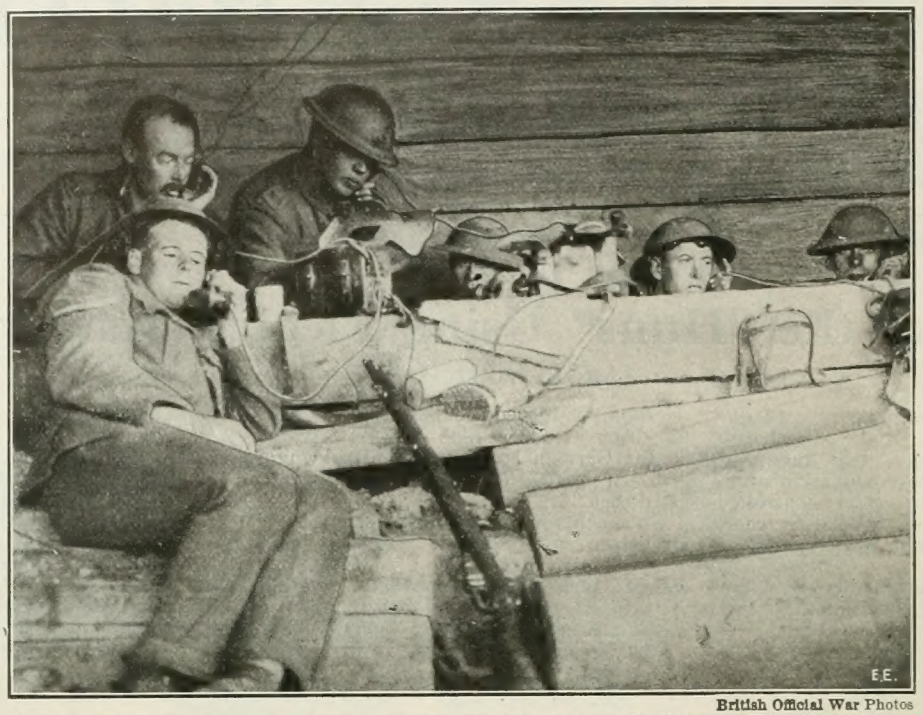
THE telephone has solved thousands of complex problems in the great conflict across the ocean, as we well know today. However, it is not often that we read very much or see photographs of military telephone stations located but a short distance from the firing line, especially those in active use by the artillery units.

The accompanying photograph is therefore of supreme interest in that the grim-looking "Tommies" in their steel helmets seen telephoning orders, are actually located in a concrete dug-out but five hundred yards from the "Boches."

The brave Britishers here shown are telephoning orders from the observation officers to the men behind the guns of an adjoining artillery unit, and altering the range figures as they are given to them by the observers.

These underground dug-outs, such as the one here shown occupied by a Signal Corps squad, are always built with the idea in mind to make them as nearly bomb and shell-proof as possible, but with the large size shells now in use, it is not unusual for these massive projectiles to pierce the roof of a "bomb-proof" and destroy it. Such work as this, of course, all comes in the day's work of the soldier.

Not only does it require men of stout heart and excellent physique, not to mention the best of nerves, for such operations when under fire, but equally as dangerous and even more so in many cases is the work of the telephone and telegraph linemen attached to the Signal Corps division of the army, who may be ordered to complete a circuit suddenly opened by a stray shell. When an advance is made, no matter whether it is large or small in magnitude, the Signal Corps men will always be found right on the job, stringing their communication lines from shell-hole to shell-hole, thru forests and across rivers.



British Official War Photos

A Recent British Photograph Which Is Remarkable In That It Shows a Telephone Dug-Out Within 500 Yards of the Boches. These "Tommies" Are Under Fire and Telephoning the Orders For Altering the Gun Range.

Without a word these men, clutching up their rifles and tools, may have to pass out into the white light of the German star-shells at night. More dangerous shells may be falling with monotonous regularity as they go forward. Such happenings go unheeded. At length they reach a shell-hole, the cause of their unwisht for promenade. If the telephone line has been broken by a shell, the work of splicing a new piece of wire to the broken ends in soon accomplisht. They then retrace their steps to the dug-out.

When a hostile trench is about to be taken, the telephone operators, in accordance with orders, wait until their comrades have taken the enemy position. The attacking forces have scarcely reached their objective before the telephone linemen are doubling across "No Man's Land," in order to establish their lines.

(*Continued from page* 589)

presents no unusual difficulty, this for the reason that the cable need only carry a single pole current, the return circuit being thru the water. A special step-by-step relay or other selective device on the vessel can serve to control several functions, by sending different impulses over the cable. At the proper time the detonating impulse would be sent thru the cable.

But granting all these things—the author would suggest—why not use an electrically controlled submarine? The idea is not new, as the Edison-Sims electric cable-controlled torpedo bears witness, not to mention several other attempts in this direction. The electrically controlled "sub," guided by a seaplane, which would "radio" back to shore its various movements, would seem to be a powerful weapon under conditions where it could be employed. According to the latest data an aviator can see a "sub" when it is submerged 100 feet under the water. There would thus seem to be a good chance of applying this scheme. Old submarines could be used for such operations.

The author has ascertained that several well-known engineers hold ideas similar to the above, concerning the feasibility of the "electric raider," including Mr. Christian Berger, inventor of the submarine wireless signaling scheme now used by all submarines.

There has been much talk of late of various fanciful and gigantic schemes for forcing a way thru the Heligoland defenses, and other heavily mined and fortified approaches, harbors and channels. Mr. Arthur Bennington, of New York, a keen observer of all war-time maneuvers and inventions, recently told the writer that he thought this "electric raider" game seemed to hold forth great promise indeed, for just such gigantic operations.

"Let us take a veritable fleet of old submarines and other nondescript vessels, and fit them with electric control cables, engines or motors, etc." said Mr. Bennington. "Load them up with high explosives and get everything in readiness. Have the Allies' battle fleet ready for business—Then start the first electric boats thru the mine fields. Every time a boat is blown up, an ever-increasing swath will be cut thru the mine field, and, woe be to the U-boat that tries to pass thru the zone under attack. It looks really very feasible to carry out just such an operation as this, with the result that before long the Allied battle fleet would be able to reach the German sea defenses and readily destroy them."

WHAT MARCONI DREW.

Mrs. Alec Tweedie's entertaining book dealing with her wonderful collection of autographed tablecloths—a hobby of hers—contains the following:

"Among the little drawings on one of the cloths," writes the authoress, "is a telegraph pole from which hangs a broken wire.

"Can you guess who drew it? The artist was sitting beside me when I begged for something more than a name. He quietly replied:

"'Well, I can draw a little, if I have time.'

"'You shall have all the time you want,' I suggested. 'We can keep the dessert waiting.'

"'No, no, I'll try to be quick. Would a telegraph pole do?'

"'Certainly, tho it will hardly be emblematic of your work.'

"'Yes, it will,' rejoined my guest, 'for I can break the wire.'"

Needless to add, the guest in question was Signor Marconi, the inventor of wireless telegraphy.

BACK NUMBERS!—Many readers desire to obtain back numbers of this journal. We have a limited quantity of these back issues on hand and can supply them at the following rates:—Back numbers of The Electrical Experimenter not over three months old, 15 cents each; over three months old, 20 cents each; over one year old, 35 cents each.

Fog Warning by Radiophone

By GEORGE HOLMES

WHETHER for business or pleasure there is not one of us who would not enjoy an ocean trip to chase away our cares and worries. Those of us fortunate to share such a luxury certainly enjoy the bright sunny decks, the beautiful skies and the fine sea air.

This is only one side tho for there are often days and nights, even weeks when storms are raging or heavy misty fogs set in, wherefore it becomes necessary for the passengers to amuse themselves indoors, in the salon, at the piano or in the smoking room swapping stories and playing cards. And—Oh, yes, ... leaning over the rail for "enlightment"?

At such times as these the grizzled sea captain must worry, for on him rests the responsibility of bringing his ship and passengers safely thru the storm.

Of recent years, inventors have constantly sought to make navigation less hazardous and each year sees new improvements along these lines. What with submarine signals, automatic engine-room signals, searchlights and wireless to keep in touch with the world and safeguard the ship, passengers travel with a really wonderful sense of safety compared to the olden days.

Lately a very important development in the line of radio has come to the aid of the lighthouse crews to assist in warning ships of dangerous shoals and rocks. We are indebted to the well-known radio inventor Dr. Lee de Forest, for this latest application of Radio. A short official description is given in a recent Hydrographic Bulletin issued by the U. S. Naval Hydrographic Office.

The first real test of this apparatus is now taking place at Point Judith Light (near Narragansett Pier) and is arranged on a very compact scale so that it can be attended to by the regular lighthouse keeper and assistant. A regulation gasoline engine connected with a 36 volt direct-current generator and storage batteries is used to supply the energy, to which is coupled a motor-generator set which operates the transmitting apparatus.

This apparatus is entirely enclosed in a very small cabinet measuring but 18x18x18 inches. On the front of the cabinet is the *Oscillion* bulb and necessary switches for regulating it; also connecting posts for aerial and ground wires. On the side of the cabinet is a small door which gives access to the mechanism inside.

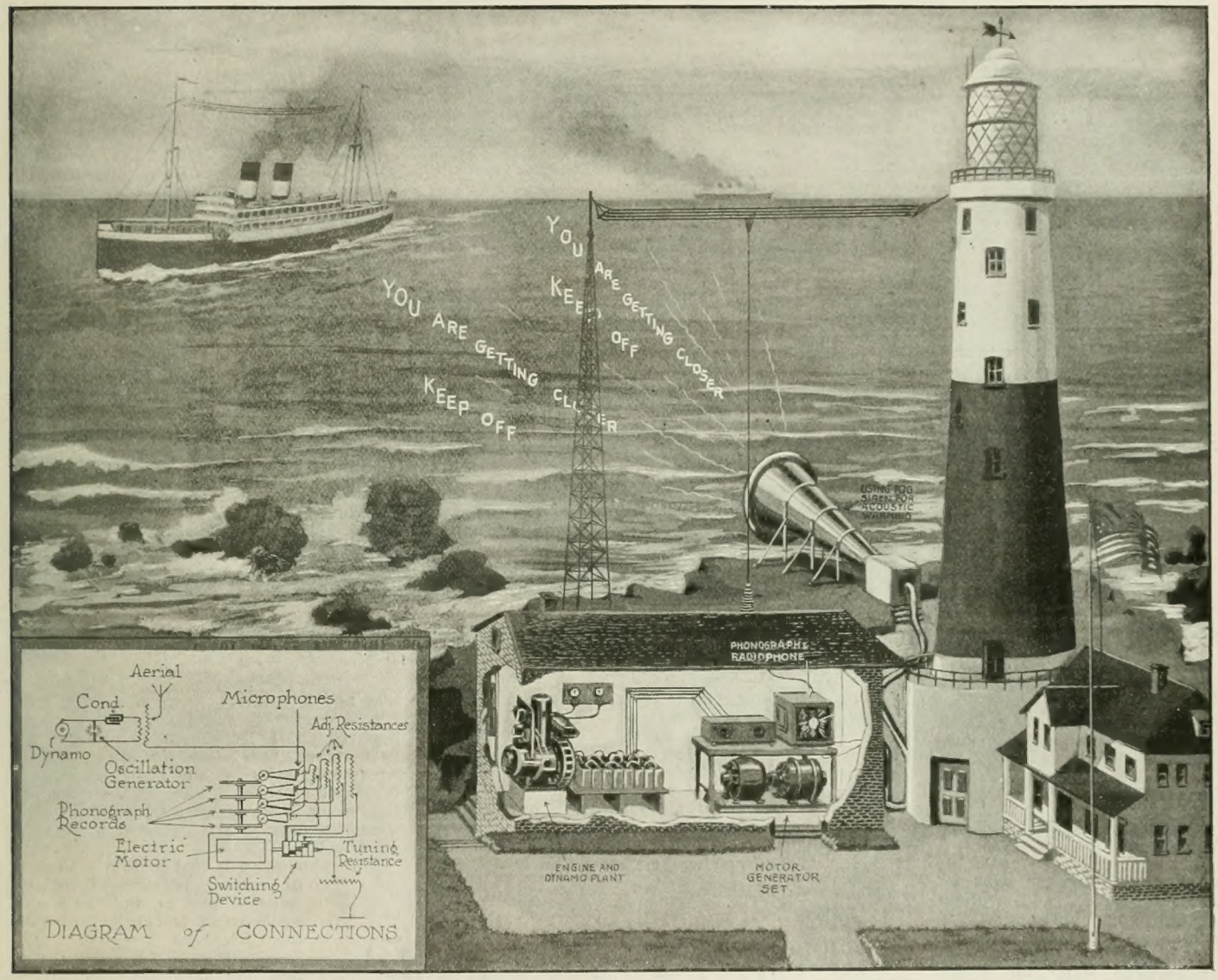
All the working parts are mounted inside the cabinet, including a motor-driven phonograph speaking directly into a microphone. The arrangement of the cylindrical records is such that they repeat automatically, the saffire needle being set back to the beginning each time after it has traveled the length of the record. Each record has an average life of about 60,000 repetitions.

The fundamental idea of this method of radiating fog warning signals, by varying quantity with ranges or power, was covered in a U. S. patent issued to Dr. de Forest in 1916, number 1,183,802, on an application filed in 1908.

In the circuit diagram may be seen the relative layout of the various horns, microphones, and the commutator arrangement which permits the proper sentence to be sent in its turn.

Several other modifications of the underlying principles may also be utilized as

(*Continued on page* 645)



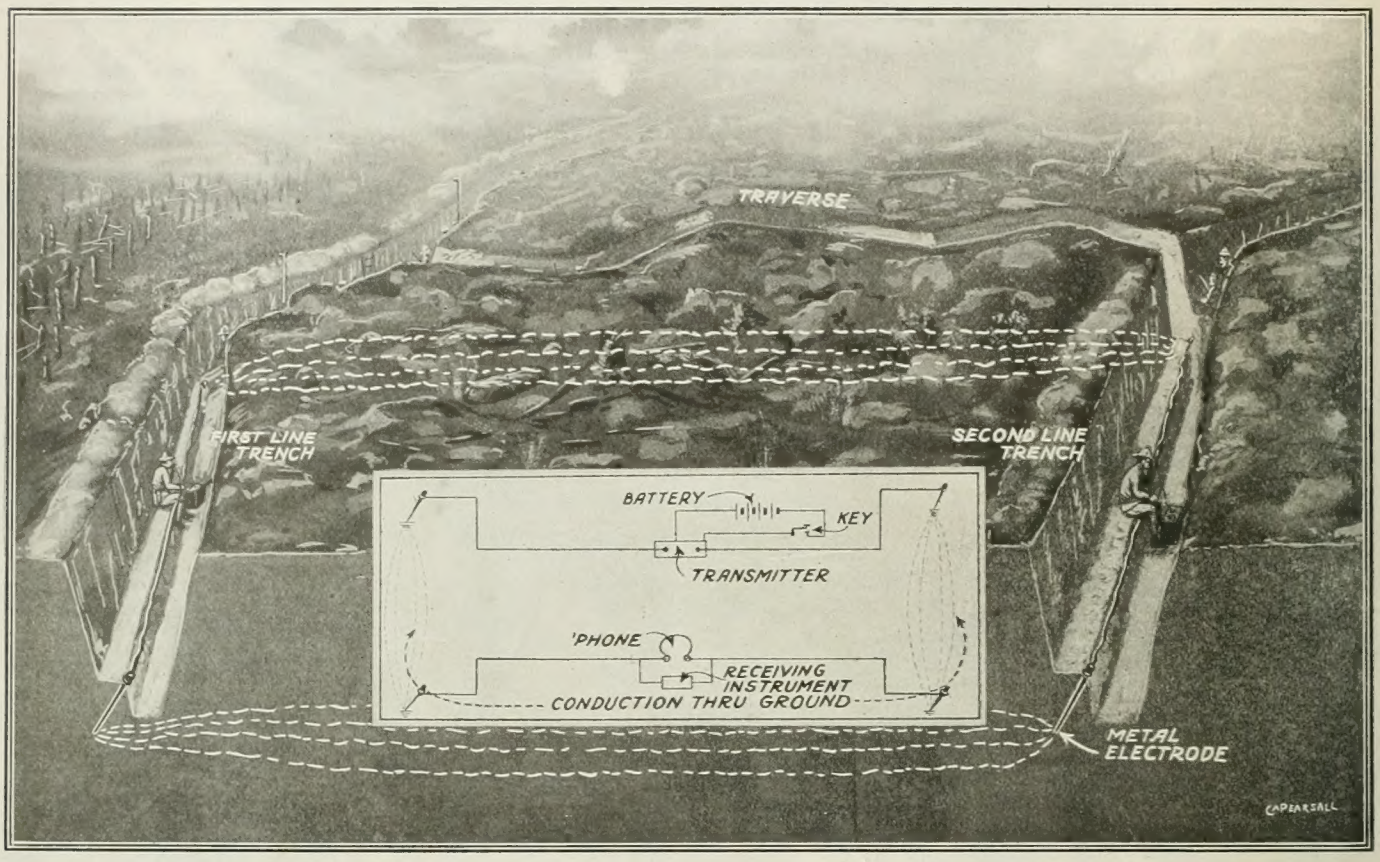
The U. S. Government Is Now Trying Out the New de Forest Radiophone Fog Warning Device Here Illustrated. By This System of Warnings It Is Possible to Radiate Either Wireless Telephone Signals or Acoustic Signals, the Latter Being Reproduced From a Phonograph, Amplified With Audions, and Propagated Thru the Air From the Regular Fog Siren Horns as Shown. Each Warning Extends For a Certain Predetermined Range.

Ground Telegraphy in War

By H. GERNSBACK

WHEN trench warfare first became an accepted fact it became of vital importance that the front trenches should be in permanent communication at all times with the supporting trenches, as well as the general command behind the lines. At first it becomes more or less an easy matter to shell these, and for that reason during the past year or so, the French have found it advantageous to do away entirely with metallic lines, running from the front to the supporting trenches, and thence rearward.

Ground telegraphy as its name implies, means sending impulses thru the earth without the use of intervening wires. The simplest system of this kind is shown in the annexed sketch where A and B are two metallic spikes driven into the ground, these spikes being connected with a bat-



A New "Wireless" Communication Scheme Is Now Being Used In the French Front Line Trenches. This Is Nothing More Nor Less Than "Ground Telegraphy" in a New Dress. By Using Specially Tuned Transmitters and Screens, Interference By the Enemy Is Practically Eliminated.

nothing but regular telegraph lines were laid, either at the bottom of the communication trenches, or otherwise the wires were suspended by some form of insulator. Such lines were not in all cases permanent, but served the purpose, as none of the wires were intended to stay up forever but were changed around more or less due to varying war conditions.

Trenches under fire make it impossible to maintain unbroken cable or wire lines, and it goes without saying that such lines are severed with annoying frequency by shell shots, bombs or surprise raiding parties. After the enemy has raided a trench, and the latter is taken away from him subsequently, there is not much left of the cables or telegraph lines, and they must be replaced immediately in order to keep up the communications with the rear. Particularly when trenches were being shelled in the past, it became a ticklish proposition to keep the lines open, as it is always the business of the enemy to search out the communication trenches with a view of disrupting the telegraph lines, which in such cases are nearly always hit.

The communication trenches being necessarily at right angles to the enemy's lines,

It has been the writer's good fortune recently to interview a French "T. S. F." *"Telegraphie Sans Fil"* officer (Wireless Telegraph Corps) and the officer in question has been kind enough to give us interesting particulars as to the new *ground telegraph* system as is now used on practically all the fronts thruout Europe. This is nothing more or less than the ground conductive system, and it is not by any means something new, having been described almost half a century back. The French, however, have added considerable new features to the system, as will be evidenced in this article.

This Diagram Gives a Clear Idea of "Ground Telegraphy." Current Impulses Sent Out Thru Electrodes A and B Will Be Heard In Telephone Connected to Spikes C and D, Due to Current Leakage.

tery and a buzzer. If we now drive two further spikes C and D, say fifty or one hundred yards (or more) away from the first spikes, *paralleling the latter,* and if we connect spikes C and D by means of a telephone receiver T, then when we operate the buzzer by means of a telegraph key the sounds will be clearly received in the far off telephone T.

The explanation is that a certain amount of current is received by the spikes C and D, and the sound while weak is readily heard in the telephone receiver. Of course, this is the crudest system, but it works surprisingly well over equally surprising distances. Not only is it possible to telegraph over such a system, but by substituting a microphone for the buzzer, and provided we have enough current, articulate speech can be transmitted over such a ground system without the use of intervening wires. It is of course not as efficient as the "ether wave" radiophone system, but has certain military applications.

A system of this kind works always at its best when the spikes A and B are separated as far as it is possible. The further the spikes are separated, the further

(*Continued on page* 646)

How Aurora Borealis Affects Telegraph and Cable Lines

Here for the first time, are told the inside facts of just how the "Aurora Borealis" affects telephone and telegraph lines, as well as ocean cables. The facts presented are from the records of a leading American electrical engineer who has been in a position, fortunately, to carry on official observations and tests on this little understood phenomenon for many years.

THE Aurora Borealis, commonly called the "Northern Lights," pays us a visit now and then, the last severe attack on telegraph and telephone circuits, as well as ocean cables, having occurred on August 9th. The display was both spectacular and demoralizing to man-made electric communication lines. A few words on this remarkable phenomenon and its origin, which is now thought to be due to sun-spots, should be of interest.

"Since a magnetic storm of the intensity of that of August 9th demonstrably has power to arrest the operation over a whole continent and a whole ocean of telegraph, cable and telephone lines, how much more intense would a similar storm have to be in order to stop the engines of prowling submarines and of soaring aeroplanes, which in one case directly and in the other indirectly depend for their functioning on electricity? The source of the disturbance is in the sun, which exercises its power of interference from a distance of 93,000,000 miles" says a well-known scientist.

"In these questions lies the new significance of such a magnetic storm as that of August 9th, which occurred coincidentally with the existence on the sun of a vast disturbance that broke up millions of square miles of its fiery surface.

"The force of that disturbance, as it reached the earth, perhaps in the form of torrents of electrons, was only sufficient to be noticed in its effect, thru the magnetic currents of the earth, upon delicately balanced energies in electro-magnetic instruments; but imagine it magnified ten times or a hundred times, and then what? Sun-spots and their repercussion upon the earth have only been studied for a few decades, and it is but a few years since we first came into possession of instruments and engines depending on electricity for their action, so that we have not yet experimental knowledge of what the maximum of this solar explosive influence upon them may be.

"There are various theories concerning the precise manner in which the solar influence is transformed to the earth. One of the most probable supposes it to be done thru shafts of invisible radiations, resembling the cathode rays, which come from the sun, and, upon meeting the atmosphere, alter the conductivity of the upper strata and thus stimulate the circulation of aerial electric currents. The shafts of radiation, or of electrons, arise from centres of violent disturbance on the sun's surface."

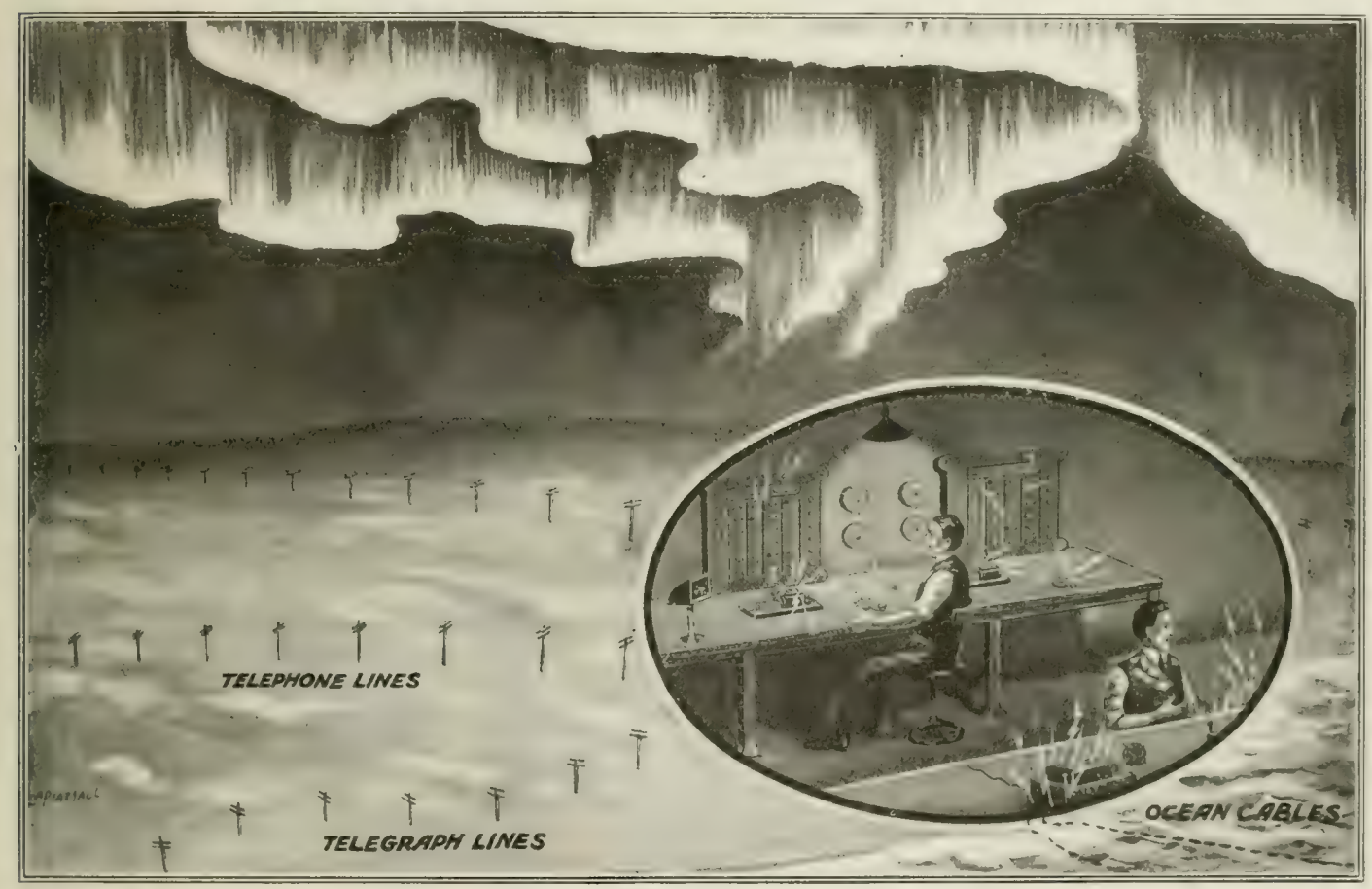
A good explanation is given by the famous French astronomer—Camille Flammarion, who explains in *L'Illustration* that these northern lights are caused by the feverish condition of the sun. It seems as if the face of the sun had broken out in a fearful rash, so numerous and so large are the spots that have been observed, some even large enough to be seen with the naked eye.

"The sun," writes Flammarion, "is always a furnace of inconceivable physical and chemical phenomena, bombardments of electrified particles and enormous eruptions of gas, of which we can gain no idea even from the thunder-bolts of heaven which flash in lightning from the clouds, nor from the thunders of man which escape from the monstrous throats of cannon. These spots on the sun are actually at least 158,000 miles in diameter. Our earth is about 8,000 miles in diameter, so it could fall into one of them and be lost."

The great streamers of light that flickered over the northern sky, like the rays of giant searchlights, on many evenings in August and September were, according to Flammarion, radiations of electric light directly from the vast volcanoes and fiery tornadoes that are torturing the face of the sun. And these radiations extend out as far as the orbit of Neptune, more than 2,793,000,000 miles away!

The action of the "Northern Lights" on telegraph and other long circuits would

(Continued on page 645)



The "Aurora Borealis" Visits Us Every Now and Then, the Last One Having Occurred on August 9, 1917. At These Times There are Severe Electrical Disturbances Set Up on Telephone and Telegraph as Well as Cable Lines. Transient Electric Currents Often Surge Thru the Circuits, Which Register a Potential of Several Hundred Volts.

The "Electro-Magnetic Depth Bomb"—Terror of the "Subs"

THE "Depth Bomb" has been featured in all recent official and unofficial despatches in which submarine activities have figured—much to the mystification of the man-in-the-street, let it be said. In the present article the general operating features of the "depth bomb" are explained as well as several new ideas which are being tried out, these modifications being due to Mr. F. R. Lewis of New York, inventor of several new war appliances, including an improved aeroplane range finder for bomb dropping, which was illustrated and described at length in the December number of the ELECTRICAL EXPERIMENTER.

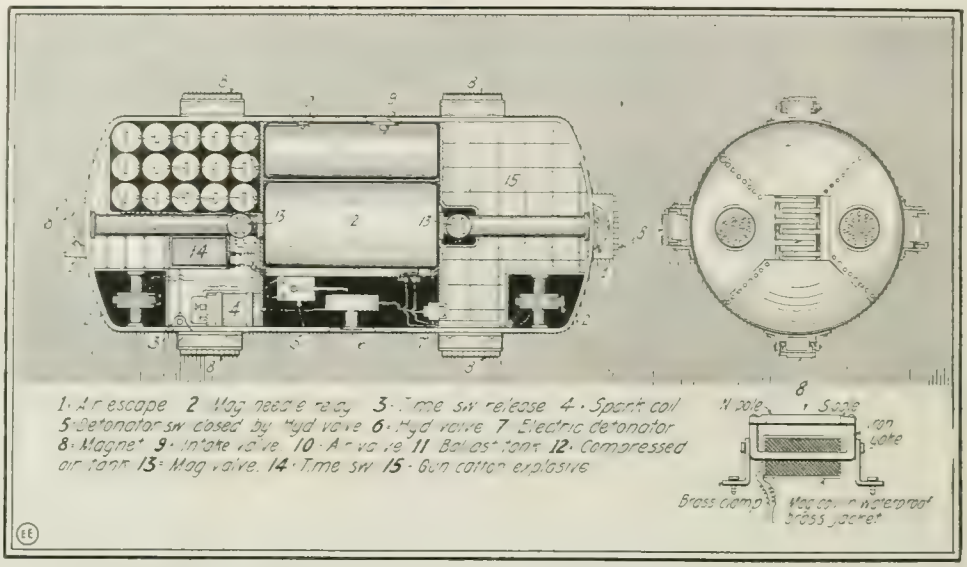
Our front cover illustration shows in a striking manner one method of using the Lewis "depth bomb." The general arrangement of this promising anti-submarine device is illustrated in the accompanying sectional drawing.

This bomb while harmless to vessels passing thru the submarine zone is sure death to the submarine that comes within the magnetic radius of its powerful electro-magnets. The bomb can be planted in waters infested by enemy submarines with the aid of patrol boats or hydro-aeroplanes. By turning the screw that opens valve (9) to the ballast chamber (11) the bomb immediately sinks under the surface of the water fifteen feet, where it lies in wait for its prey. If by chance a merchant or patrol vessel should attract the bomb, the bomb would attach itself to the side of the vessel. It should be understood that this electro-magnetic depth bomb is not of the class constantly invented by well-meaning but electrically uninformed patriots, wherein the magnet is supposed to pull the ship or the bomb thru a radius of several yards. The Lewis depth bomb is fitted with powerful multipolar electro-magnets all over its outer shell in the manner here shown. These are not normally excited, but as soon as a submarine comes within a few feet of it, the presence of her iron mass causes a sensitive magnetic needle relay to close the battery circuit thru the powerful electro-magnet nearest to the submarine's hull. If the submarine is close to the depth bomb, the bomb will attach itself to the submarine, all unknown to the "sub's" crew. Besides all this use is made of a comprest air tank and two discharge jets, one at either end, the air jet farthest from the "sub." being actuated by a magnetic valve opened by the magnetic relay 2. The depth bomb will be propelled toward the "sub." by the escaping air, even tho the bomb is several yards away.

If a patrol or merchant vessel happens to pick up any of the electro-magnetic depth bombs, it must be remembered that they stay at a fixt draft, which renders the bomb *harmless to them*, but when a submarine picks one up (all unknown to its crew) it is harmless only until the submarine dives to fire a torpedo at its prey. The submarine must go to a depth of at least 30 to 35 feet, when the water pressure causes the hydrostatic valve (6) to work the electric switch (5) which in turn operates the spark coil (4) exploding a powerful high explosive charge in the chamber (15). The charge is heavy enough to blow in a plate or two or cause the plates to be blown in to such an extent that the submarine would sink in a very few minutes, so that the subsea craft, by its very act to destroy, destroys itself.

There is provided an airtight chamber around all electrical parts and the explosive chamber, as the bomb lying in the water, would be affected by the different temperatures which would cause *sweating* (condensation) and this moisture would sooner or later cause the bomb to become dead and consequently harmless. A special time switch is provided which keeps all circuits open until after a predetermined time period, thus enabling the ship's crew to cast them overboard and get away from the spot before the depth bomb becomes active.

These depth bombs can be cheaply made and could be planted by the hundreds in the zones picked out for this purpose, at night, (or by seaplanes in the daytime) and as the bomb sinks to a depth of fifteen feet, there is nothing to show the enemy where danger lurks. The hydro-static valve is controlled by a tension spring and set-screw indicator which can be adjusted for the bomb to explode at a predetermined depth of 30 to 100 feet.


1·Air escape 2·Mag needle relay 3·Time sw release 4·Spark coil
5·Detonator sw closed by Hyd valve 6·Hyd valve 7·Electric detonator
8·Magnet 9·Intake valve 10·Air valve 11·Ballast tank 12·Compressed air tank 13·Mag valve 14·Time sw 15·Gun cotton explosive
Nose
Gate
Brass clamp
Mag coil in waterproof brass jacket

The "Electro-Magnetic Depth Bomb" Represents the Latest Departure in the Design of Anti-Submarine Devices. These Bombs Are Harmless if Picked Up by Steamships. When Picked Up by an Enemy Submarine, However, They Make Short Work of It, For When the "Sub" Dives, the Increased Water Pressure Explodes the Bomb.

The depth bomb would seem to have distinct advantages for carrying on anti-submarine operations in such waters as those off the coast of Belgium, and in the German coastal waters of the North Sea. The Allied war-vessels cannot enter these thickly mined waters, anyway. They are netted off to a large extent so that floating depth bombs would hardly menace the Allied ships. But the "Huns" in their subsea war-vessels know safe channels thru the mined areas and manage to cut thru nets and finally show up "somewhere in the Atlantic." When Uncle Sam's aerial fleet reaches the other side, and even with the present Allied air-fleet, it ought to be possible to sow the forbidden water areas with tens of thousands of such electro-magnetic depth bombs. Depth bombs seem to be very efficient.

SUCCESSFUL RADIO SCHOOL UNDER NOVEL CONDITIONS.

A free Government school to train radio operators for the rapidly-growing American merchant marine has been established at Boston thru the initiative of Radio Inspector Arthur Batcheller, of that city, with the active assistance of Mr. Walter Butterworth, assistant radio inspector. When Congress made its first appropriation for building merchant vessels Mr. Batcheller, at that time assistant radio inspector at Boston, was quick to realize that a large number of commercial operators would be needed, and in June he suggested to the Commissioner of Navigation the establishment of a free school which, unlike the great school conducted by the Navy Department, would accept only such applicants as would agree to take a position in the merchant marine. The suggestion was approved and Mr. Batcheller was authorized to carry out his plans.

Thru the coöperation of the collector of customs permission was obtained to use the office of the radio inspector in the Boston customshouse during the evening for school purposes. Benches and tables were made from second-hand lumber obtained thru the assistance of the Customs Service, and camp stools were loaned by the Boston & Gloucester Steamship Co. Thru the mayor of Boston the loan of a blackboard was secured from the school department. The Marconi Wireless Telegraph Co. aided the project by supplying a typical radio installation, and the Bureau of Navigation furnished the necessary head telephones, telegraph keys, dry cells, wire, buzzers, etc.

These facilities permitted the instruction of a class of 40 men, and nearly that number are taking advantage of the opportunity. The classes meet three evenings a week and the work is progressing with marked success. The school opened on July 16, and each student will have an opportunity at the end of a six months' course to win a first-grade commercial radio operator's license.

The instruction is under the supervision of Mr. Batcheller, who had previously had four years' experience as a teacher of electricity and radiotelegraphy. The Secretary of Commerce has visited the school and has officially commended Mr. Batcheller and Mr. Butterworth for their helpful and patriotic service. They have had the active assistance of Mr. McCarthy, clerk in the radio inspector's office, and of Mr. E. W. Thompson, chief electrician, radio, United States Navy.

Electric Buoys to Mark Torpedoed Ships

By E. T. JONES, Chief Electrician; Radio, U. S. N. R. F.

RECENTLY I have seen and read much in regards to torpedoed ships, the raising and saving of the same, and some of them are indeed excellent ideas. Now of late I have been studying this subject myself and I have devised a method, here illustrated, by which ships could be raised if the proper apparatus were used to do so.

The main idea is to fit all merchant ships with the buoys shown, having enclosed inside of them coils of cable on a reel which unwind as the ship goes down. The buoy staying afloat access can be had to the cable by means of an entrance at the top of the buoy. The ship could be fitted with eight or more of these "floaters" and by using powerful floating cranes or other means of lifting, the lost ship could easily be brought to the surface and then towed to shallow water where it could be entirely saved.

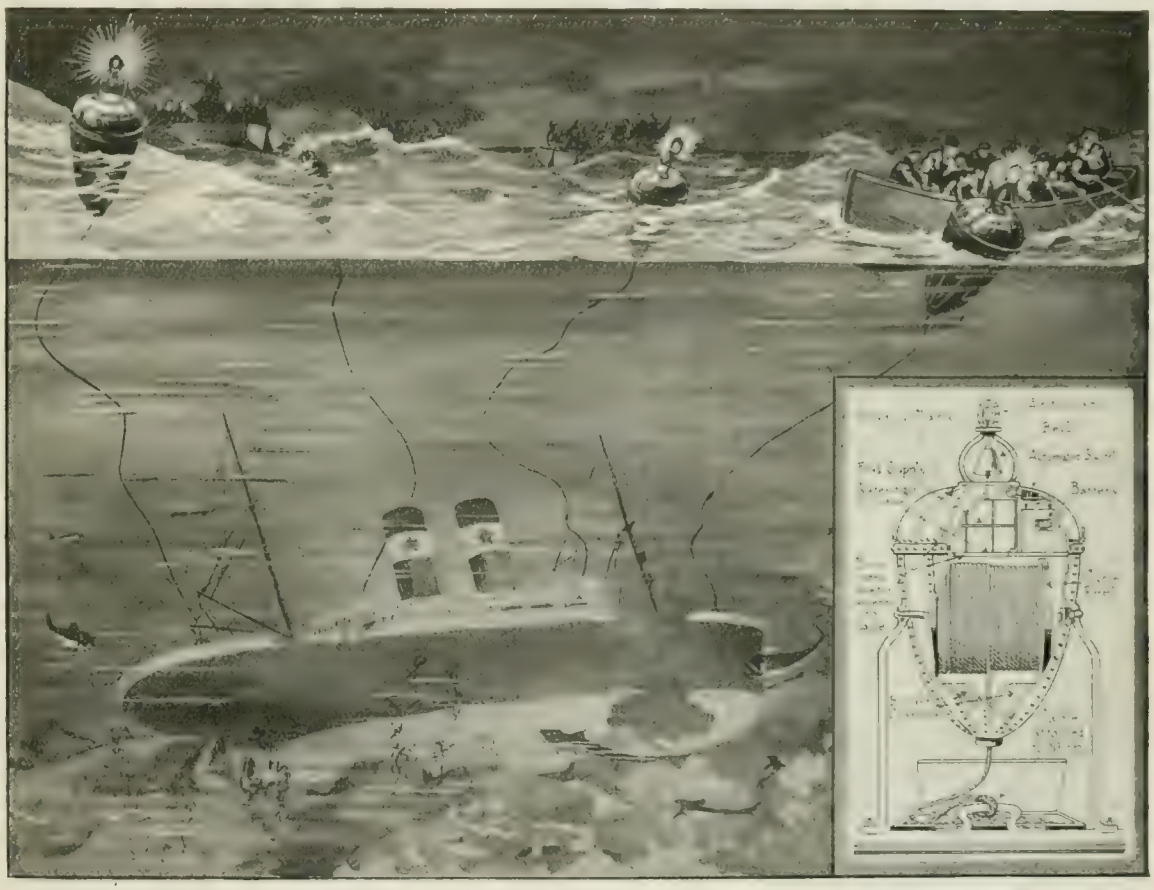
It is, of course, taken into consideration if the ship were sunk in mid-ocean that the cable could not be long enough, in fact the buoy would have to be too large, but if each ship were fitted with these buoys and a reasonable amount of cable inserted in each it would be no more than taking another chance, but this time a chance which would probably save the ship.

The buoys themselves could even be supplied with food when nearing the danger zone and should the ship be sunk this food could be used by the victims until relief came. Means of holding on to the buoy could also be supplied and add to the life saving devices now supplied on board every ship.

Several details of importance would have to be taken into consideration with such a device as this. For one thing the enemy would surely cut the cables if the buoys floated to the surface as soon as the ship sank. Some kind of retarding device, such as a slow-emptying ballast tank, would solve this problem, so that the buoys would float to the surface only after a period of several hours.

Further, it is not feasible, as aforementioned, to fit these buoys with a great length of heavy cable. Therefore, it would seem a good idea to equip the buoys with reels of fine steel wire only, which could then be of considerable length, owing to its light weight. Under each buoy position on the vessel there could be provided a magazine chamber in the hold, in which a suitable length of heavy steel cable could be stored on a reel. The action of the buoys so equipt would then be as follows:

Say the vessel was torpedoed; the eight or more buoys would, after several hours, float to the surface, carrying their fine wire connections from the sunken craft. If now salvage operations are to be started in an effort to raise the wreck, the buoy covers are opened and by pulling up on the small wires, automatic clutches are released on the deck of the sunken boat, permitting the heavy cable in the magazines to be pulled up. After the heavy cables are all pulled up to the surface, they are made fast to the lifting derricks. For that matter it would also be practical to arrange a second buoy to float the heavy cable to the surface, this buoy being released by pulling on the fine guide wires already described. The buoys would be fitted with a storage or other battery to light the lamp and an automatic switch to close the lamp circuit after the buoy reached the surface.



One of Uncle Sam's Naval Men Has Suggested a New Salvaging Scheme for Saving Sunken Ships. He Proposes to Equip Every Boat with a Series of Electrical Buoys, which Rise when the Ship Sinks. These Buoys Carry Cables From the Ship, and May Carry Electric Lights as Well as Food for the Survivors.

AMERICA'S ELECTRICAL CHRISTMAS CAMPAIGN

Some years ago, Thomas Edison predicted that it wouldn't be very long before practically everything that required labor in the home, would be done by "electricity."

Everyone knows to what extent labor, time and money saving electrical appliances have been introduced into the home, and how energetically and successfully central stations, electric shops, contractors and others have been promoting the use of such devices. But it has been only with the sudden descent of war upon this country that the full meaning of Edison's words, and their great portent comes to us.

Apropos of this question of selling Electrical appliances, this year's campaign of *The Society for Electrical Development;* "America's Electrical Christmas" comes along at a most opportune time. Never before in the history of the industry was there a time when electrical merchandise played the part it will this year.

These facts, and others, have all received the most careful attention in a book just publisht by the Society, which is being sent gratis to members and non-members alike, upon request. It is designed for Central Stations and dealers who have Arrived, those who are Already There, those who are Going, and the Just Started. It is a big book, 48 pages and covers, printed in many colors, profusely illustrated thruout, and filled with practical, timely suggestions, built for stores of all sizes in cities of all sizes.

The book has some twenty chapters, treating on everything from the store and window display, to the use of two very excellent "movie films" which the Society has prepared, in coöperation with the Universal Film Mfg. Co. All the helps, copy, cuts, etc., are furnished practically free to members and non-members along the same broad liberal policy heretofore manifest in such previous campaigns as America's Electrical Week, Electrical Prosperity Week, Wire-Your-Home-Time, etc. Readers are advised to correspond with the Society for Electrical Development, 29 West 39th Street, New York City.

SALVADOR—MEXICAN WIRELESS.

Wireless communication has been establisht between Mexico City and San Salvador. The wireless plant at the Salvadorean capital was presented to that country by Mexico and installed by Mexican electricians.

Training U. S. Aviators with Electric Map

UNCLE SAM has a real job on his hands now—namely, to train thousands of aviators in a few months. And they must be good aviators—capable of looping the loop with one hand, if need be—while with the other they proceed to flash a radio report to earth, telling just where the shells are hitting. Therefore, every student learns wireless; no one can gain his commission without passing a rigid examination in this indispensable art. Probably the most interesting work is that performed in the miniature range. This gives the student that preliminary instruction in artillery spotting which is perhaps the most useful service rendered by the aeroplane, says Burton J. Hendrick in the *World's Work*. In one of the instruction halls at Ohio State University is an immense picture map of a section of Belgium. It shows the city of Ypres and all the surrounding country, including every farmhouse, barn, country road, open field, river and pond. In a gallery, about ten feet above this map, sit several of our future aviators. They are supposed to be in aeroplanes, six thousand feet in the air.

The scale of the map is so graduated that, as they gaze down upon it, the terrain appears precisely as it would look were these men actually flying in the air at that height. Their business is to locate "exploding shells" and *wireless* back to their own batteries the accuracies or inaccuracies of the aim. And shells are actually exploding all the time on this miniature sketch of Belgian territory below them; not real shells, perhaps, but representations that convey a complete illusion.

Under the map, which is of paper and therefore transparent to light, are located hundreds of little electric light bulbs. The professor, by touching the appropriate button on a lamp control switch-board, can light his selected bulb, the little flash appearing on the map giving a complete representation of an exploding shell. The apprentice airman in the gallery selects the German battery which his own men are attempting to destroy. The professor touches off his imitation shells in close proximity to this battery—these are supposed to represent American attempts to reach the mark. As soon as each shell explodes, a tapping is heard up in the little gallery; *the student is wirelessing to his friends, telling them how far they have come from hitting the object.*

The U. S. Aviation School At a Western University Has Adopted an Electric Map for Coaching Future Birdmen. The Instructor Pushes a Button, a Light Under the Map Flashes, and the Students In the Balcony Must Instantly Locate Where the Supposed Shell Hit. The Students Telegraph Their Results To the Instructor.

The wireless message may take such cryptic form as telling the American battery that it is "ten o'clock and three hundred yards." This may puzzle most people, but it locates precisely the spot where the shell has fallen. For purposes of signaling the German battery is taken as the centre of a clock, with twelve o'clock pointed perhaps due north. When the airman signals "ten o'clock" this means that the shell has exploded on an imaginary line which would represent the clock pointer in this direction. The "three hundred yards" gives the distance between the exploding shell and the German battery.

The business of the student is to locate these exploding shells almost instantaneously. Unless he gains great proficiency in a short time, he has no future in the American air service. In no department of the service can mistakes become so costly and cause the loss of so many lives. The fate of battles may easily depend upon the reliability of the information wirelessed back by these aërial scouts. Clearly this is no business for a boy who does not have sharp eyes, a perceiving brain, a quick wit and absolutely boundless courage. The young men at the Ohio State University, perched in their gallery above this map of Belgium, can exercise all their gifts of observation and all the quick mental reactions necessary to fulfill their duty, but they cannot, after all, reproduce all the atmosphere of the aërial battlefield. In the calm of this university hall he works in peace, while, when in action, he will be threatened with attack by German airmen, constantly seeking to interrupt his little game. The school experience can train the future airmen's skill, but it cannot train his nerves. The rapidity with which the students are learning this art, however, and the eagerness which they manifest in the entrancing game, argues well for their actual work in the field.

Eight weeks they spend in the ground school. Those who survive this experience are past on to the flying field, such as that at Dayton. Here they continue their school work and also learn the real work of flying a plane and after eight weeks here they are transported silently to an American port and shipt to France. Here an American aviation school receives them, and thence they advance, by slow stages, to the "front."

SCIENCE AND INDUSTRY.

Sir Isaac Newton, shortly before his death, said: "I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me"—yet Liebnitz estimated that Newton had achieved far more than all other mathematicians put together from the beginning of history. Lord Kelvin, at his jubilee, in reply to the homage of the whole scientific world, said: "One word characterizes the most strenuous of the efforts for the advancement of science that I have made perseveringly during fifty-five years; that word is failure." Yet he towered above all his scientific contemporaries, and was perhaps the greatest savant that the world has known. It is, in fact, a trait common to all who have spent their lives in the pursuit of knowledge, and have acquired a profound acquaintance with the hidden mysteries of nature and science, that they, more than all others, realize the immensity of the field that lies open before them—shrouded in mists, it is true, and beset with pitfalls, *culs de sac,* false clues, but also holding treasure in store of inconceivable richness for the reward of those who patiently grope amid its gloomy fastnesses. We have as yet but ventured over the border of that illimitable expanse; the further we penetrate into its depths the better we appreciate the wealth that lies beyond, and the greater becomes our strength to overcome the difficulties that confront us. We see, too, how far we have strayed from the true path in the complacent past when we thought we had approached finality in one or another quest.

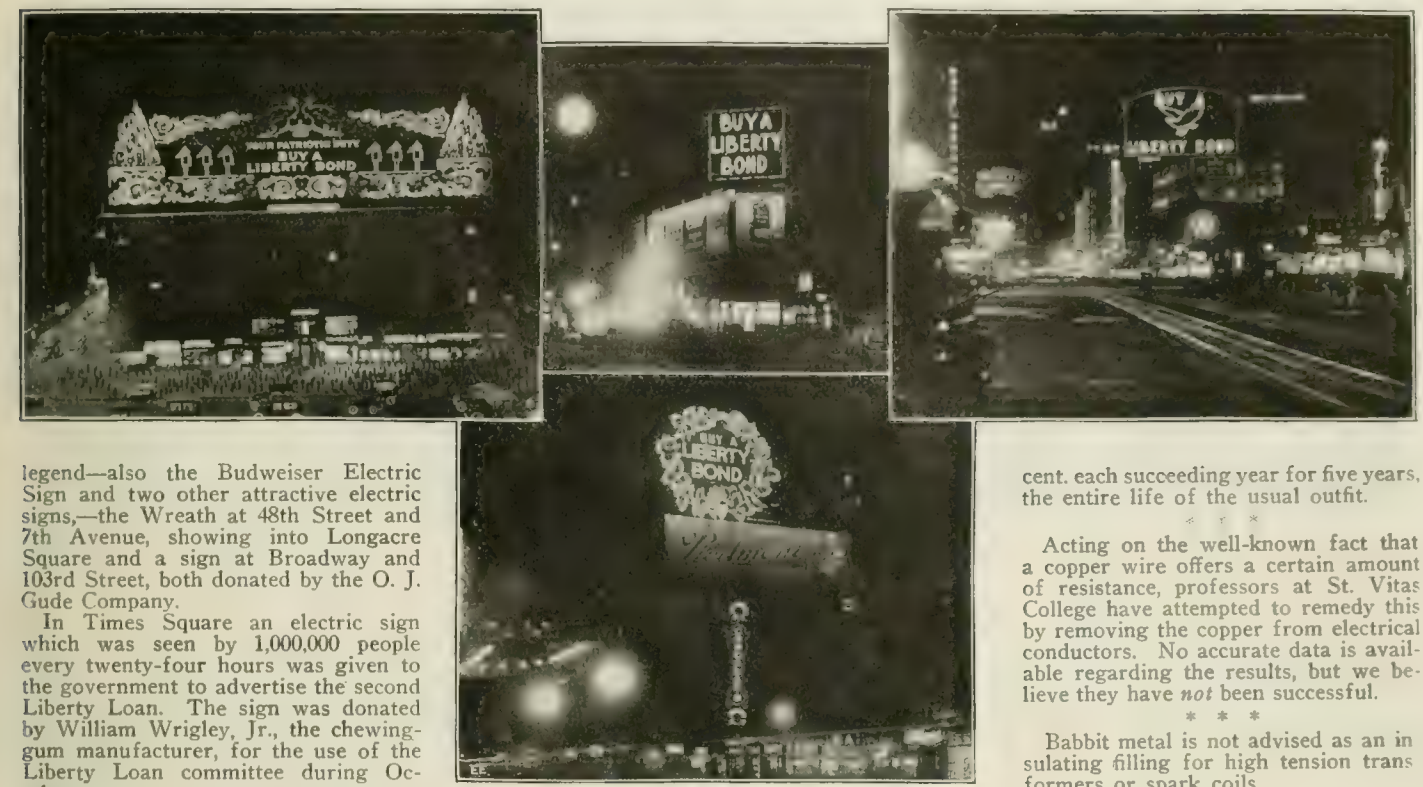
"Liberty Loan" Electric Signs

THE good people of New York City were not permitted to go pleasure-hunting along the "gay white way," without being frequently reminded that "your patriotic duty is to—BUY A LIBERTY BOND!" Electric signs large and small blazed the immortal message forth so successfully that the metropolis out-bid itself and bought considerably more than its allotted share of patriotism.

The accompanying photographs show the Wrigley Electric Sign with Liberty Loan legend—also the Budweiser Electric Sign and two other attractive electric signs,—the Wreath at 48th Street and 7th Avenue, showing into Longacre Square and a sign at Broadway and 103rd Street, both donated by the O. J. Gude Company.

In Times Square an electric sign which was seen by 1,000,000 people every twenty-four hours was given to the government to advertise the second Liberty Loan. The sign was donated by William Wrigley, Jr., the chewing-gum manufacturer, for the use of the Liberty Loan committee during October.

The statistics of the gigantic Wrigley sign are as follows:—The structure extends 56 feet in height and 200 feet in length. At either end are two magnificent fountains 34 feet high, at the top of the sign in the center are two majestic peacocks facing each other, each 60 feet long from head to tip of shimmering tail. The artistic gold scroll work border of the sign is entwined with beautiful varied colored flowers—all reproduced in electric globes—approximately 15,000 of which showing eight different colors, are required for the sign. The reproductions of the famous Spearmen, three on each side of the sign, are 15 feet high. These jolly little men are in constant action—they dance, salute, march, shoulder arms and present arms. The sign costs $5,000 a month to run. The Budweiser sign is 44 feet high by 73 feet long, and the Eagle is 24 feet high, by 22 feet wide. The Wreath is 33 feet high, and the sign at 103rd Street, while not as large as the lower Broadway signs, has a showing as far as 96th Street—one of the most important night sections of upper Broadway.—*Photos courtesy O. J. Gude Company.*



How New York Boosted the "Liberty Loan" With Flashing Electric Signs. "Buy a Liberty Bond" Greeted Your Eyes from Every Angle. Upper Left View Shows Mastodonic Sign Donated By William Wrigley, Jr., the Chewing Gum Manufacturer. It Measured 200 Ft. in Length.

ECCENTRIC ELECTRIC EFFLUVIA.

By Thomas W. Benson.

Despite the number of petticoats on a high tension insulator they do not noticeably hamper the kick.

* * *

The International Brotherhood of Blowouts at their last annual convention adopted the pronoun "She" when referring to fuses. Their action was based on the fact that a fuse, like a woman, "goes off" when least expected.

* * *

A prominent storage battery manufacturer has announced that powdered glass is highly unsuitable for filling storage batteries.

* * *

A recent Underwriter's ruling prevents the laying of wires or cables in existing water pipes, on account of the damping effect experienced in the past.

* * *

Water has been found to be a poor substitute for oil in transformers.

* * *

At present tests are being made with a new type of ship that has one half of the hull made of copper and the other half of zinc. Calculations tend to show that the electrical energy derived from the battery thus formed will give the craft a speed of some 17.3 yards per minute.

* * *

Brocaded arc lamps with sateen ruffles have been announced by a Chicago concern. It is reasonable to presume that they will meet with great demand by the fashionable ladies for their boudoirs.

* * *

Cast glass boots are being supplied to the linemen of a power company in the middle west to protect them from shocks.

* * *

The DeNutt Power Co. have equipt all their engine room chairs with glass legs so the operatives in the generating plant may lean against the bus-bars without danger. That's comfort!

* * *

While drawing short-circuits on feeders it is suggested that dark glasses be worn to protect the eyes.

* * *

Special wet cells have been devised for use in "prohibition" states.

* * *

From close observation extending over a number of years an efficiency engineer has calculated that the depreciation on an electrical doorbell equipment is 163.3 per cent. the first year, decreasing some 23 per cent. each succeeding year for five years, the entire life of the usual outfit.

* * *

Acting on the well-known fact that a copper wire offers a certain amount of resistance, professors at St. Vitas College have attempted to remedy this by removing the copper from electrical conductors. No accurate data is available regarding the results, but we believe they have *not* been successful.

* * *

Babbit metal is not advised as an insulating filling for high tension transformers or spark coils.

* * *

An attempt to use one wire for feeder and return has failed, according to recent reports from Dubort, Mich.

* * *

A novel method of extinguishing an incandescent lamp under some conditions is to tap it with a small hammer. Two or three taps are usually sufficient to obtain the results desired.

* * *

The carrying capacity of a plug fuse may be appreciably increased by filling it with mercury.

* * *

Water turbine generating sets have been falling into disuse as watchfobs of late; steam plants seem to be taking their place in many localities.

* * *

By clamping the shaft of an ordinary electric fan in a vise and switching on the current a very interesting collection of by-products is thus formed.

MAZDA LAMP PRODUCTION.

In 1907 the carbon electric incandescent lamp business represented 99 per cent of the total sales; in 1916 the relative proportion between these lamps and the Mazda lamp has practically been reversed. The change has been brought about since the public has learned that the Mazda lamp will give three times the amount of light as the carbon lamp will give on the same amount of electricity.

Bronze Tablet to Mark First Edison Station in New York

TWENTY-TWO pioneers of the electric lighting industry assembled at the Electrical Exposition in New York City on October 18th to take part in the dedication of a tablet which is to mark the site, at 257 Pearl Street, of New York's *first electric central station.* Among the men were many who worked with Edison in laying out the original station and distribution system. Edison himself, however, was unable to attend the dedication—his work on the Naval Consulting Board taking up all his time.

Addresses were made by Boro President Marcus M. Marks, of Manhattan; Dr. George F. Kunz, president of the American Scenic and Historic Preservation Society; John W. Lieb, president of the National Electric Light Association; Reginald Pelham Bolton, Dr. Edward Hagaman Hall and P. C. Magnus, occupant of the building on which the tablet has since been placed. Arthur Williams, president of the Electrical Exposition presided.

A feature of the exercises was the gathering of 22 of the men who worked with Edison in establishing the first central station at 257 Pearl Street, where the tablet has since been placed. Some of these men are now executives of big electrical companies. All cheered enthusiastically when the announcement was made that their old boss, Al Edison, was too busy helping to win the big war to have time to attend the historic event.

Among the central-station pioneers who gathered at the reunion were William J. Hammer, Schuyler S. Wheeler, E. A. Harley, H. A. Campbell, Joseph Lee, A. T. Brown, O. J. P. Lang, A. E. Gilbert, W. J. Brown, J. F. Atkins, T. T. Wooley, Edward G. Acheson, Wilson S. Howell, Richard Darlington, Thomas Brown, W. T. Dempsey, Mrs. Nellie Curran, Andrew Brown, John W. Lieb, Arthur Williams.

The bronze tablet has since been erected at 257 Pearl Street, New York, marking the site of the first Edison electric lighting central station plant in America and commemorating the beginning of Edison service in the metropolis. The bas-relief at the top of the tablet shows the interior of the old Pearl Street station. (See also separate view of old station.) The generators, six in number, were each of 150 horsepower. The territory served by the station was only a square mile in area and the station began operation Sept. 4, 1882, at 3 P. M., with four hundred lights on the system, and on Oct. 14, 1882, about six weeks later, there were 85 houses connected, wired for 2,323 lamps.

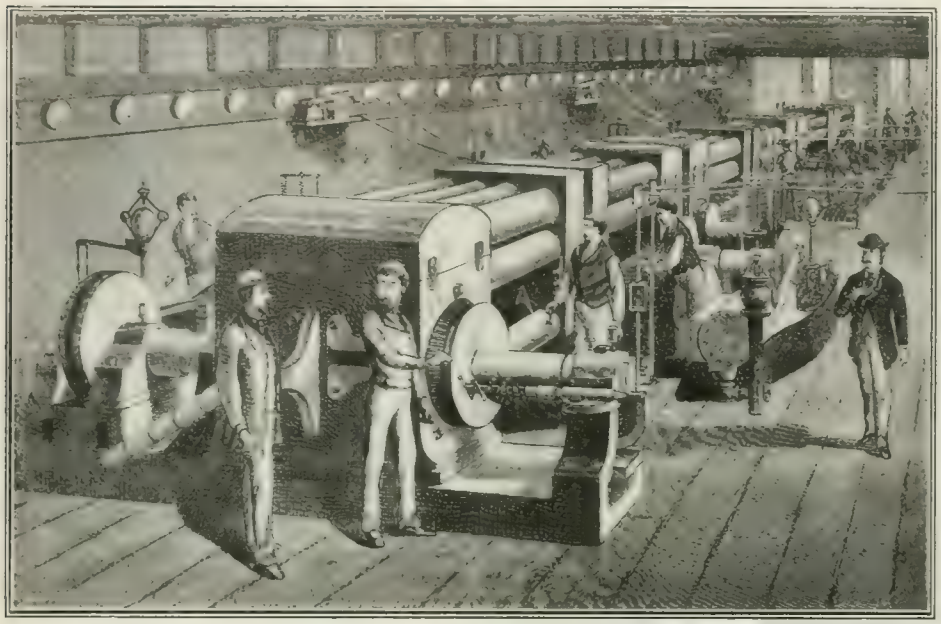


Photo courtesy New York Edison Co.

Interesting Picture of the First Edison Central Station in America, Which Was Officially Started Sept. 4, 1882, With a Load of Four Hundred Lights on the System. In Six Weeks' Time the Load Had Increased to 2,323 Lamps.

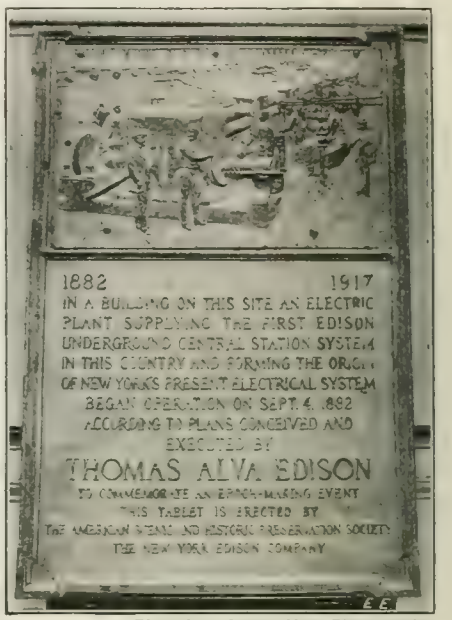

1882 1917
IN A BUILDING ON THIS SITE AN ELECTRIC
PLANT SUPPLYING THE FIRST EDISON
UNDERGROUND CENTRAL STATION SYSTEM
IN THIS COUNTRY AND FORMING THE ORIGIN
OF NEW YORK'S PRESENT ELECTRICAL SYSTEM
BEGAN OPERATION ON SEPT. 4, 1882
ACCORDING TO PLANS CONCEIVED AND
EXECUTED BY
THOMAS ALVA EDISON
TO COMMEMORATE AN EPOCH-MAKING EVENT
THIS TABLET IS ERECTED BY
THE AMERICAN SCENIC AND HISTORIC PRESERVATION SOCIETY
THE NEW YORK EDISON COMPANY

Photo from Central News Photo Service

Handsome Bronze Tablet Which Now Marks the Location of First Edison Central Station at 257 Pearl St., In New York City.

In erecting the tablet, the American Scenic and Historic Preservation Society and the New York Edison Company have coöperated. On September 4, 1882, electric current was generated by the six 150-horsepower "Jumbo" dynamos, each dynamo weighing 60,336 lbs., or roughly 30 tons, and having a capacity of 1750-16 C. P. Edison lamps each. Up to the time of the construction of Edison's giant "Jumbos," two men could lift almost any other dynamo in the world. Today these dynamos would seem very small; probably even these pioneers with all their confidence and prescience never conceived how the force to whose generation this plant was devoted was destined to revolutionize the life of the city. Save Edison; for even before he perfected the incandescent lamps, which on that afternoon blazed out four hundred strong at the turn of the station switch, he had invented a motor modeled on the dynamo which he himself had also designed. In 1888 some printing presses on Pearl Street were operated by the strangely successful application of electricity and this

(*Con. on page* 647)

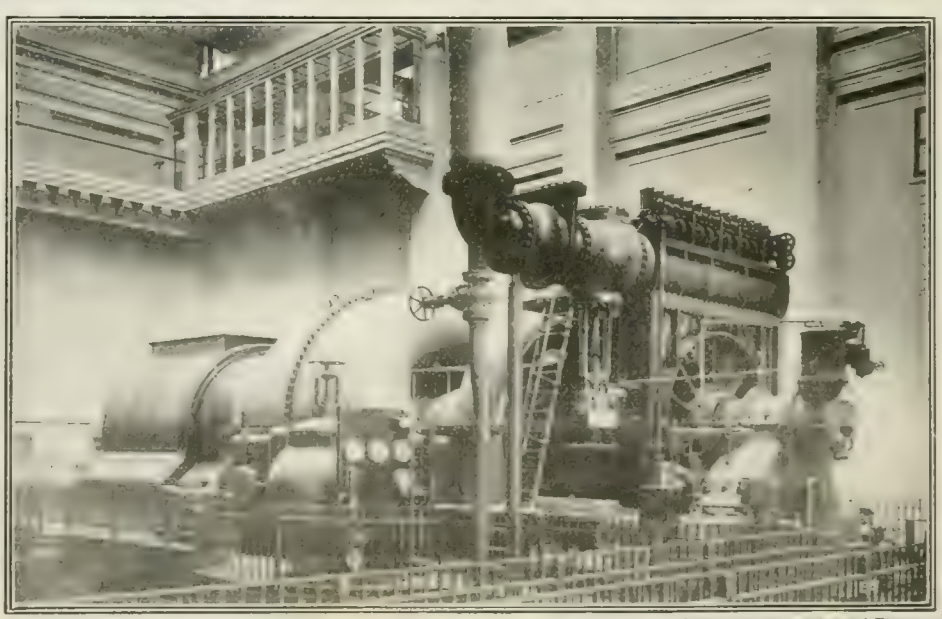


Photo courtesy of General Electric Co

This Powerful Turbo-generator of Modern Type, Not So Much Larger Than the Early "Jumbo" Dynamos Shown Above, Develops 67,000 H.P. The "Jumbo," a Wonder In Its Day, Developed 150 H.P. Or 1-450 As Much.

The X-Ray on the Battle Front

AFTER many trials and tribulations it is indeed fortunate to secure the accompanying photographs showing a few of the great marvels being accomplisht in war-ravaged Europe by means of Röntgen rays, and we are greatly indebted to Captain Dr. Thurston Holland of Manchester, England, for the Figs. 1 and 2 here shown. For every invention and appliance made to make the war's toll large, the Red Cross and Medical Units are equally struggling to alleviate the sufferings of the wounded and bring back to usefulness the shattered limbs of our heroes. All the photos are authentic and show real conditions as they exists at the present time.

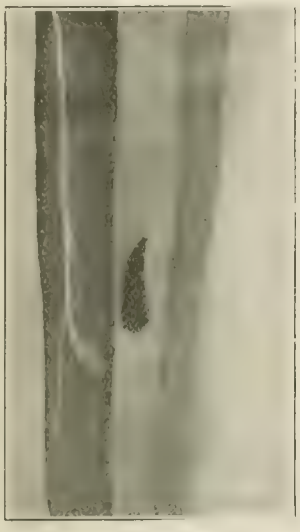


Fig. 4. The Case of Private "J. M.," B. E. F. The Bullet Fractured the Bone and Deflected to the Position Shown.

We are indebted to Captain Dr. J. D. Morgan, of the British Army Medical Corps for Figs. 3 and 4, in archives of Radiology and Electrotherapy, London.

The greatest benefit probably comes from the ability of locating shrapnel, as this usually covers a wide area in the affected parts as shown in Fig. 1, a photo showing a shrapnel shell wound in the hand.

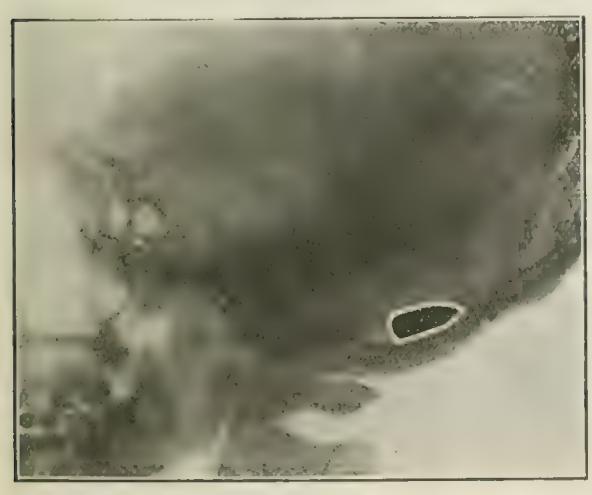


Fig. 2. "A Bullet In the Brain" Was the Diagnosis of the X-ray in This Case—and the Victim Lived.

A peculiar case is cited in connection with Fig. 2, the photo showing a bullet in the *brain.* A young officer was wounded in battle and in the rush and hurry at the advanced dressing station, the bruise on the head was taken for a slight scalp wound. While on leave, he complained of a pain in his head and decided to have the surgeons make a thoro examination, when to both their own and the officer's surprise, upon using the X-rays, it was found that he had been walking around with a *bullet in his brain.*

In Fig. 3, may be seen some of the terrible havoc that shrapnel is doing. In this radiograph the shattered bones may be seen and also the safety-pins which are holding the bandage around the hand and arm. Fig. 4 shows wherein the new methods of exact location of foreign bodies may be practically applied. The difficulty of estimating the depth of the bullet is obvious and the bullet is distinctly shown, also a fracture of the bone resulting most likely from the bullet striking same with resulting deflection.

Thru the courtesy of Dr. Sinclair Tousey of New York we give the folowing data on the new methods now being used in accurately localizing foreign bodies by X-rays, thereby eliminating all guesswork on the part of the surgeon when he starts to remove a bullet or other foreign body.

Localization by means of *radiography* presents no difficulty in the case of a finger. Here there are distinct, long land-marks and it is easy to take two pictures in planes at a right-angle to each other. And if we employ a ray vertical to the plate at the supposed position of the foreign body, the latter is so near the plate that no correction is required for the slight lateral displacement of its shadow, if not exactly at the spot where the ray is normal.

In many other cases two radiographs taken at right-angles are either impracticable or are totally inadequate, owing to the thickness of the part X-rayed, the absence of very accurate long land-marks and very often the great distance of the foreign body from the surface. In these cases radiographic localization resembles a problem in surveying like the exact localization of a point upon an island by observations from the mainland. The exact depth at which the foreign body is located is the difficult problem to be solved and solved quickly.

With this end in view some fifty-seven methods of radiographic localization have been publisht, many of them called forth by experience gained in the European war. The many methods employed may be said to follow somewhat the following general plan:—The patient is placed in an appropriate position in contact with the photographic plate, a small metallic *marker,* fastened to the surface of the body, shows in the picture and so does the foreign body; then without changing the position of the body relative to the plate, but with a measured displacement of the X-ray tube a second picture is made. The two positions of the image of the foreign body afford a means of determining the direction and distance of the foreign body from the spot where the metallic marker is fastened to the surface.

Or the finished picture may be laid on the table and above it are fastened two points in the positions occupied by the anticathode of the X-ray tube during the two exposures. From these two points threads are stretched to the two images of the foreign body and the juncture of intersection of these two threads is the point at which the foreign body was located when the pictures were made.

Dr. Tousey's localization method is new and distinctive, as well as a modification, of the above method. The apparatus required is:—A piece of galvanized iron netting measuring 8x10 inches and having meshes ⅛ inch square and the wire being of such a thickness itself that there are seven meshes to the linear inch. A single distinctive lead marker such as a small ring is also used as well as a set of lead numerals. There are also facilities for moving the X-ray laterally a measured distance

(*Continued on page* 636)

Fig. 1. "Explosive" Effect of Shrapnel Shell in the Hand. The Shell Splinters Are Clearly Visible In This Skiagram Taken At a British Base Hospital

Fig. 3. The Case of Private "W. D.," B. E. F. Showing What Happened When the Bullet Struck the Bone, Shattering It. Note the Bandage Pins.

HOW A GERMAN TELEPHONE OUTPOST LOOKS

The accompanying photo shows a German telephone outpost in operation on the Somme front. It is one of the first German pictures to arrive in this country since America's entry into the war.

Photo © by Kadel and Herbert

One of the Few Recent German War Pictures to Reach the United States. This Shows a Typical German Telephone Outpost Near the Front Line Trenches. The Military "Telefon Vorposten" is a Fighter as Well as Electrician.

This photo shows only one of the many thousand German telephone outposts that are being used by the Kaiser's fighting legions on the Somme and other fronts. The military telephone linemen who install and maintain these front line instruments are all armed and often have to fight for their lives, as might be expected. In other words the *"Telefon Vorposten"* as he is called, is a soldier first and a telephone expert afterward. Some of these telephones are installed in dug-outs and shell holes even beyond the front-line trench.

It is really wonderful how the men of the signal corps actually contrive to place their listening posts right under the noses of the enemy. More often than not the telephone squad has to work its way from shell hole to shell hole, with ever-watchful snipers blazing away at them every time they expose their bodies. But the commanders must know at all times just what is transpiring all along the front and here we have our answer as to the supreme necessity of the telephone outpost here shown.

SPIES USING RADIO ON U. S. SHIPS?

In a statement recently issued the Patriotic Society, with headquarters in Washington, D. C., makes the flat declaration that German agents have been placed on American merchant ships for the purpose of betraying them in the submarine zone.

The wireless, it is charged, is used for this purpose, signals are flashed from port holes, a smoke pillar is employed by stoking the fires in a peculiar way, and at night a stream of sparks is substituted for the smoke by day.

Because of the situation which is declared to exist the society makes a plea for the manning of American merchant ships by the Naval Reserve. The statement says in part:

"German agents, it has now become certain, have been placed upon American merchant ships for the purpose of betraying them when the submarine zone is reached. These agents are German seamen, posing as neutrals, and neutral subjects in the pay of the Imperial Government.

"The wireless is frequently used to summon the U-boat to its prey. At night signals are flashed from port holes. In some cases the fires are stoked in such a way that a long, thick veil of smoke trails over the horizon marking the way of the ship. If the passage is made at night the firing is done in such a way that a shining trail of sparks point out the victim as clearly as if a giant searchlight had been turned upon her.

"Recently an oil steamer was sighted by a submarine. At a time when the U-boat was still at a distance, the fire crew deserted their post in a body. The men appeared on deck with life-preservers belted on, ready to take to the boats. An army officer happened to be on board. He looked at the oncoming U-boat, noted the distance she was away and calculated that there was still an opportunity to escape. At the point of the pistol he compelled the deserters to return to the fire room and the tanker was saved.

"The use that is made of the wireless on shipboard, however, is giving our navy men the most serious concern. Besides informing the submarines of the vessel's whereabouts the ship's wireless affords the German spy system an opportunity of communicating information of importance from the United States. Such messages can be sent within a few hours after any given vessel has cleared from an American port."

Anyone having information that would help the good work along should write the society.

A 30,500 MILE TELEGRAPH CIRCUIT.

During the World's Series baseball contest the Associated Press had its entire system of leased wires looped together at the various centers, so that the sending operator at the baseball grounds communicated directly with every newspaper served by the association. The mileage of the circuit was approximately 30,500 miles, or 500 miles longer than that of a year ago.

A HANDY PORTABLE LIGHTING OUTFIT

Difficulty is necessarily experienced in underground work because of the lack of light. This is particularly true of manhole work where the only natural light obtainable comes thru the entrance to the manhole from the street, and the limited amount of space is such that practically in every position a man works in a manhole he is bound to obstruct his own light. Because of this fact a good electric light is most essential and a portable light is the only practical one. The accompanying illustration shows a portable battery lighting outfit developed for just such a purpose.

This set is neatly and compactly installed in a small steel black enameled box. The equipment includes an Edison storage battery consisting of 5 cells completely assembled in a tray, fully charged, ready for immediate service, together with two properly guarded 12 C.P. lamps with reflectors and with eleven foot leads. One of these lamps can be used for 20 hours on one complete charge of the battery, constantly burning. Both of them will burn for ten hours

Due to the use of the Edison storage battery no injury from overcharging or from complete discharging occurs. The electrolyte is a non-corrosive, alkaline solution; no acid being used. The manhole electric lighting outfit is a portable unit and for this reason the question of weight is most important. The outfit shown can readily be handled by anyone and carried an unusual distance without effort. The complete outfit, battery and all, weighs only 40 pounds.

The actual cost of maintenance and operation is really very small. The cost of upkeep on one battery for one year has been found to be less than 10 cents. By connecting a suitable number of batteries in series and figuring on a 10 cent rate per K.W. hour for current it costs less than 10 cents to fully charge each battery from a completely discharged condition.

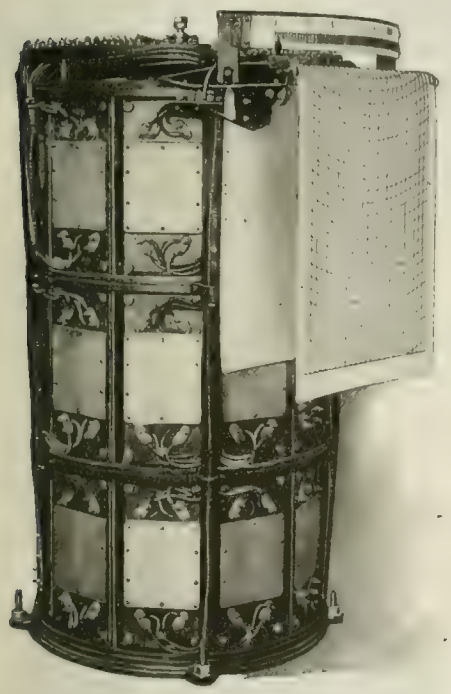
For Lighting Manholes, Cable and Pipe Tunnels, and a Hundred Other Places, This New Storage Battery Lighting Outfit Will Prove Ideal.

HUGE ELECTRIC METER RECORDS 250,000 KILOWATTS.

The largest graphic recording meter in the world is illustrated in the accompanying cut. It has a capacity of 250,000 kilowatts and is installed in the Keokuk plant of the Mississippi River Power Company. To meter the output of the thirty three-phase generators used in this plant required the use of thirty polyphase meter elements, each made up of two single-phase units. In carrying out the design of this instrument the desirability of using the same general design in other instruments was borne in mind, with the result that the supporting frame was made up of three sections as shown, each carrying ten polyphase meter elements, thereby making it possible to construct a similar instrument of ten elements or any multiple of ten up to fifty.

The induction type of meter element was adopted, after having devised an element capable of being calibrated mechanically for torque without effecting the correction for power factor. The moving element consists of six aluminum vanes, all mounted on a single staff, supported in such a manner as completely to eliminate friction.

All connections are carried to the top of the instrument to a circular terminal board carrying 240 binding posts, four being used for each single-phase meter element. The actual width of chart is 12.5 in. (31.8 cm.). The charts used are printed



Talking of Recording Electric Meters Compare this Giant, With a Capacity of 250,000 Kilowatts to Your House Meter. This Meter is as Tall as a Man and the Largest Ever Built.

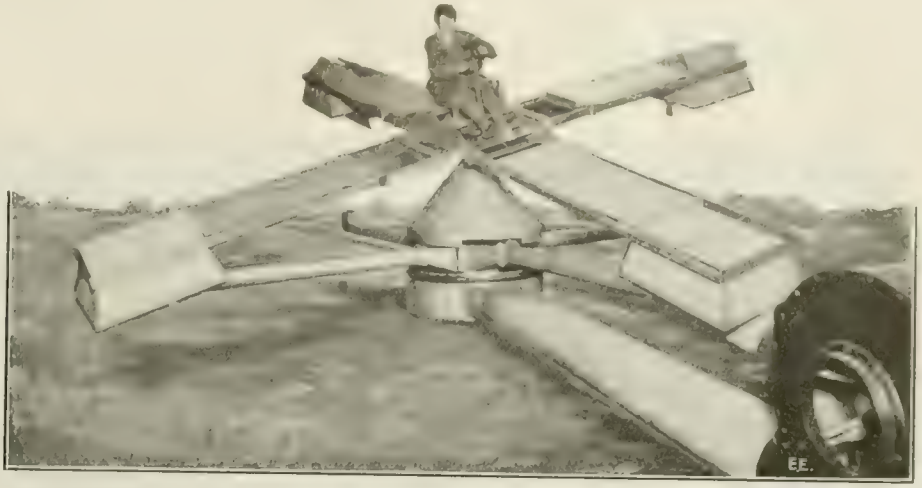
in twelve-hour sections and fed at the rate of 3 in. (7.6 cm.) per hour over two rollers, one of which carries pins for driving the paper and is rotated by means of a solenoid-operated ratchet connected in the electric clock system of the plant. The indicating scale which faces the system operator's desk is illuminated and graduated to the same range as the chart.

With an instrument of this type it is possible to totalize the output of a station of any capacity or a number of stations or systems, regardless of differences in frequencies, voltage and whether or not they are in synchronism, and instruments of the same type can be built for any number of circuits from five to fifty.

"Teratuter"—An Electrically Operated Flying Teacher

American inventive ingenuity has already solved the problem of speeding up the training of aviators. Considered scientifically, an aviator can move his aeroplane only in three dimensions while flying:—he can point it up or down, or prevent it from pointing up or down which is one; he can tilt it to the right or left, or prevent it from so tilting, which is two; or he can turn it to the right or left, or prevent it from turning, which is three and the limit of his control. From the combinations of these three movements, combined with the forces of the motor and gravity, "flying," with more or less proficiency, results.

The *Teratuter*, as the apparatus is called, was developed from the notion that if a man could be drilled to produce those identical movements with the identical wheels and levers that are used on an actual aeroplane, to the point where he could do it *instinctively* with the precision and speed of the accomplisht aviator, and the drilling done on a dummy aeroplane mounted to go thru a full range of the aeroplane's movements, much expensive flying practise would be dispensed with. The Teratuter is operated by a powerful blower driven by an electric motor.



The Powerful Electrically Driven Blower Seen At the Extreme Right Produces Strong Air Currents Which are Caused to Alternately Blow Against the Four "Wings" of This Aviation Teaching Machine So As to Reproduce Actual Flying Conditions.

Most of the more proficient of the world's famous aviators attained their wonderful control of the aeroplane by sitting in their machines, closing their eyes, and persistently operated their controls in long imaginary flights.

Aside from the field value of the Teratuter, it can be erected in college buildings to accompany the theoretical training of those who are to become officers in aviation corps. The one in the illustration. (the first one invented) is an accessory of a New York flying institution.

To make the device as realistic as possible, it is operated by a great volume of comprest air. The inventor, himself an aviator, has adjusted the aeroplane members which produce or correct the Teratuter's motion to be about equal to the movements of a real aeroplane flying in a 40 mile per hour wind.

ILLUMINATED FLAG PROVIDES HANDSOME DISPLAY.

Everyone wants to show his patriotism now. Everyone can now show the colors night and day with this handsome electric flag. The flag is mounted on heavy board 12 x 18 inches with easel and hanger, and is equipt with Mazda lamps and six foot leader cord. It can be put in the window, the doorway or a dozen other appropriate places and provides a good advertisement as well as patriotic display. It is particularly well adapted for residence decorations and looks well in the front window of any house or apartment.

ONE TON OF METER JEWELS.

One ton of saffires will be used during the year 1917 in one factory where the jewelled bearings of electric meters are made. The jewels are purchased in the rough and are put thru finishing and drilling processes which require a degree of skill comparable only to that of an experienced watchmaker.

Three thousand electric fans are to be used on the cargo handling ships which are now under construction for the United States shipping board.

One of the Latest House and Show-Window Decorations Is This Electrically Illuminated Flag. It Is Small Yet Distinctive and Attractive.

Modern Physics and the Electron

How Professor R. A. MILLIKAN, the brilliant American Scientist, made the "Electron" visible and how the electrical dimensions of the "Electron" have been measured

IF you have any respect for my subject or any respect for me, you will not expect me to outline in the space of one brief hour the work of modern physics. It is utterly impossible to do, and I can say that without affecting an inordinate egotism.

The spirit of modern science is something relatively new in the world's history, and I want, as an introduction to the main address, to give an analysis of what it is. I want to take you up in an aeroplane which flies in time rather than in space, and look down with you upon the high peaks that distinguish the centuries, and let you and me see together what is the distinguishing characteristic of this century in which we live. I think there will be no question at all, if you get far enough out of it so that you can see the woods, without having your vision clouded by the proximity of the trees, that the thing which is characteristic of our modern civilization is the spirit of scientific research—a spirit which first grew up in the subject of physics, and has spread from that to all the other subjects of modern scientific inquiry.

That spirit has three elements. The first is a philosophy, the second is a method, and the third is a faith, said Prof. R. A. Millikan recently before the *American Institute of Electrical Engineers* at New York. Look first at the philosophy. I say that is new for the reason that all primitive peoples, and many that are not primitive, have held a philosophy that is both animastic and fatalistic. Every phenomenon which is at all unusual or for any reason not immediately intelligible used to be attributed to the direct action of some invisible personal being. Witness the peopling of the woods and streams with spirits by the Greeks; the miracles and possession by demons of the Jews; the witchcraft manias of our own Puritan forefathers, only two or three hundred years ago.

Now, that a supine fatalism results from such a philosophy is to be expected, for according to it everything that happens is the will of the gods, or the will of some more powerful beings than ourselves. And so, in all the ancient world, and in much of the modern also, three blind fates sit down in dark and deep inferno and weave out the fates of men. Man himself is not a vital agent in the march of things, he is only a speck, an atom which is hurled hither and thither in the play of mysterious, titanic uncontrollable forces.

Second, as to the method of science, it is a method practically unknown to the ancient world; for that world was essentially subjective in all its thinking and built up its views of things largely by introspection. The scientific method on the other hand is a method which is completely objective. It is the method of the working hypothesis which is ready for the discard the very minute it fails to work. It is the method which believes in a minute, careful, wholly dispassionate analysis of a situation; and any physicist or engineer who allows the least trace of prejudice or preconception to enter into his study of a given problem violates the most sacred duty of his profession. This present cataclysm which has set the world back a thousand years in so many ways, has shown us the pitiful spectacle of scientists who have forgotten completely the scientific method, and have been controlled simply by prejudice and by preconception. (Referring to the World-War.)

In the mystical, fatalistic ages which preceded, electricity was simply the agent of inscrutable Providence; it was Elijah's fire from Heaven sent down to consume the enemies of Jehovah; or it was Jove's thunderbolt hurled by an angry God; and it was just as impious to study so direct a manifestation of God's power in the world as it would be for a child to study the strap with which he is being punished, or the mental attributes of the father who is behind the strap. It was only one hundred and fifty years ago that Franklin sent up his famous kite, and showed that these thunder bolts were identical with the sparks which he

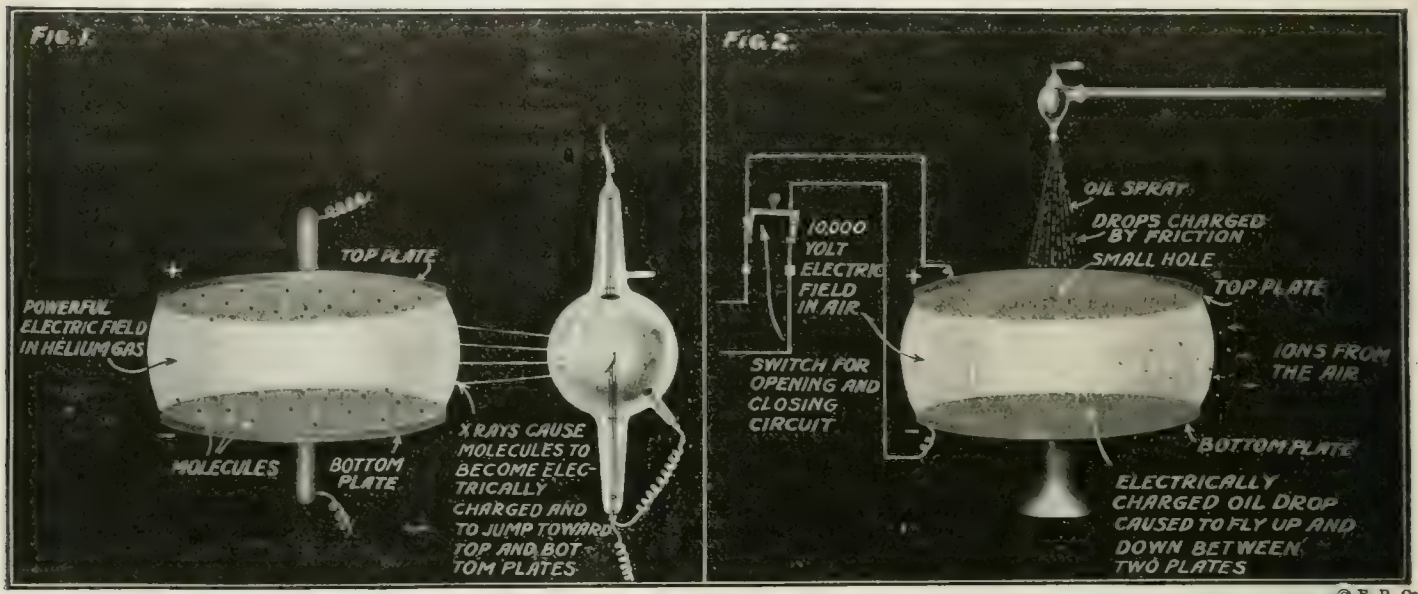


Fig. 1
TOP PLATE
POWERFUL ELECTRIC FIELD IN HELIUM GAS
MOLECULES
BOTTOM PLATE
X RAYS CAUSE MOLECULES TO BECOME ELECTRICALLY CHARGED AND TO JUMP TOWARD TOP AND BOTTOM PLATES
Fig. 2
OIL SPRAY
DROPS CHARGED BY FRICTION
SMALL HOLE
10,000 VOLT ELECTRIC FIELD IN AIR
TOP PLATE
IONS FROM THE AIR
SWITCH FOR OPENING AND CLOSING CIRCUIT
BOTTOM PLATE
ELECTRICALLY CHARGED OIL DROP CAUSED TO FLY UP AND DOWN BETWEEN TWO PLATES

© E. P. Co.

Fig. 1. If We Have Two Plates With an Electric Field Between Them and Nothing Else but a Monatomic Gas Like "Helium," Then This Gas Remains Stagnant When the Field Is Thrown On. A Beam of X-Rays Shot Between the Plates, However, Causes Some of the Molecules to Become Electrified and to Jump Toward the Plates, This Effect Being Measurable.

Fig. 2. Using Two Plates Charged With 10,000 Volts, It Became Possible to Isolate a Single, Minute, Charged Oil Drop and to Alternately Move It Up and Down by Switching the Electric Field On and Off. This Oscillating Particle Was Found to Attract Ions From the Air, Signaling Each Capture to the Observer by the Change in Its Speed in the Field.

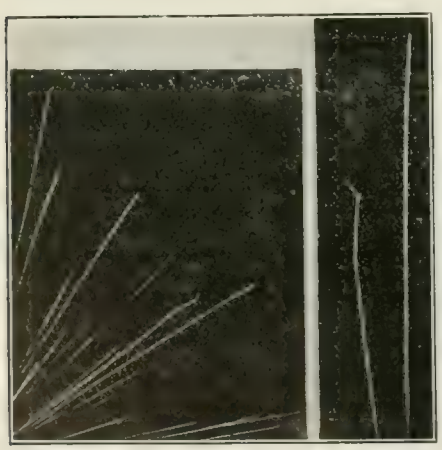


Fig. 3. Actual Photographs of the Tracks of "α"—Particles Shooting Thru the Air. We Now Know That These "α"—Particles Do Not Penetrate the Air After the Manner of a Bullet, i.e., by Pushing the Molecules of Air Aside, but Rather That They Actually Shoot Thru All the Molecules of Air Which They Encounter. An "α"—Particle Would Have to Make About 500,000 Such Passages Thru Molecules in Traversing 2.75 Inches of Air.

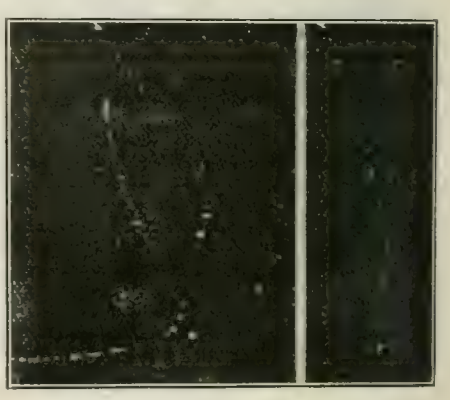


Fig. 4. Here Are Actual Photographs of "h"—Particles Shooting Thru Air. Cut At Right Shows Track of Very High Speed "h"-Ray. This Particular Particle Shot Thru On an Average as Many as 10,000 Atoms Before It Came Near Enough to an Electronic Constituent of Any One of These Atoms to Detach It From Its System and Form an Ion. This Shows That Electronic Constituents of Atoms Can Occupy but a Very Small Fraction of the Space Inclosed Within the Atomic System.

could draw on a winter's night from his cat's back.

And at the end of the nineteenth century there were many of us physicists and engineers who thought that all the great discoveries had been made. It was a common statement that this was so. I heard it publicly made in 1894, and yet within a year of that time I happened to be present in Berlin at the meeting of the Physical Society at which Röntgen showed his first photographs, and since that time we have had a whole new world, the very existence of which was undreamed of before, opened up to our astonished eyes.

We have found a world of *electrons* which underlies the world of *atoms* and *molecules* with which we had been familiar, and the discoveries in that world have poured in so rapidly within the last twenty years that there are no two decades in human history that compare at all with them in the rapidity of the advance. And these discoveries have been made too for the most part by groups of men interested merely in finding out how nature works. They have been made almost exclusively by college professors; and for ten years they remained the exclusive property of these professors. What has happened in the last ten years? The industrial world has fallen over itself in the endeavor to get hold of these advances, and by their aid it has increased ten-fold the power of the telephone, it has obtained four or five times as much light as we got a few years ago out of a given amount of electrical power, it has developed new kinds of transformers the existence of which was never dreamed of before—all these things are coming *now*, it is not in the distant future, that we are going to find the applications; we have found in the last five years a great quantity of them, and how many more are going to come, no man call tell.

Finally, before launching upon the sea of recent discovery, I wish to make one more remark about the method of science, namely this: The progress of science is almost never by the process of revolution. You see a great deal in your newspaper headings about revolutionary discoveries. They almost never happen! Thus when the atom was found not to be an ultimate but a divisible thing, there was no revolution, there was not a single law that had to be given up. We had simply opened up a new field, tapt a new lead, found an unexplored region, a sub-atomic region, and all that was above it remained just exactly as it had been, and no chemist had any occasion to be disturbed, for the chemist's laws were just as precise as they had been before. Sometimes we do indeed find that we have generalized too far, and that some law which we had supposed to be of universal application is limited in its scope, but this does not alter the fact that the growth of science is in general by a process of accretion, almost never by that of revolution. Once in a while we have something revolutionary, but not often.

We may aptly characterize the physics of the last twenty years as the physics of atomism, and the first discovery on my list is the recent verification of the adumbrations of the Greeks regarding the atomic and the kinetic theories—the proof that, as Democritus had imagined 500 B. C., this world does indeed consist, in every part of it, of matter which is in violent motion.

Up to within six years there were not a few distinguished scientists who withheld their allegiance even from these atomic and kinetic theories of matter. The most illustrious of them was Professor Wilhelm Ostwald, but in the preface to a new edition of his *Outlines of Chemistry* he now says frankly:

"I am convinced that we have recently become possest of experimental evidence of the discrete or grained nature of matter for which the atomic hypothesis sought in vain *for hundreds and thousands of years.* The isolation and counting of gaseous ions on the one hand. . . . and on the other the agreement of the Brownian movements with kinetic hypothesis. . . . justify the most cautious scientist in now speaking of the experimental proof of the atomic theory of matter. The atomic hypothesis is thus raised to the position of scientifically well-founded theory."

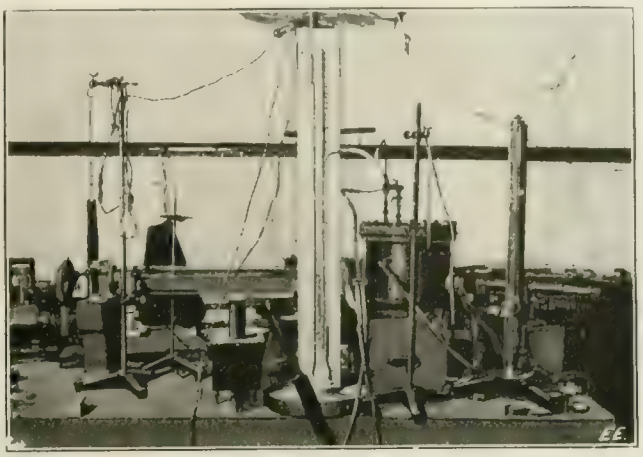


Fig. 5.—The Precision Apparatus Used by Prof. Millikan At the University of Chicago Laboratory For Determining the Physical and Electrical Constants of the "Electron." The Condenser Plates (See Figs. 1 and 2, Also Fig. 6 Below) Were Made With Surfaces Polished Optically to Such an Accuracy That the Error Was Less than One Part in 10,000.

I think you all know what the Brownian Movements are but I wish especially to call attention to the fact that this advance was made not by a practical man, but by a man who never did any experimental work in his life, Einstein, a mathematician, a man who was capable of analyzing a theory and predicting results, and the experimentalists have checked those results. The results consists in predicting how far a given particle that you can see in an ultra microscope will drift in a given time, and our own experiments have checked this prediction to within one-half per cent. It is that sort of evidence that has convinced Professor Ostwald of the correctness of the new kinetic and the atomic theories.

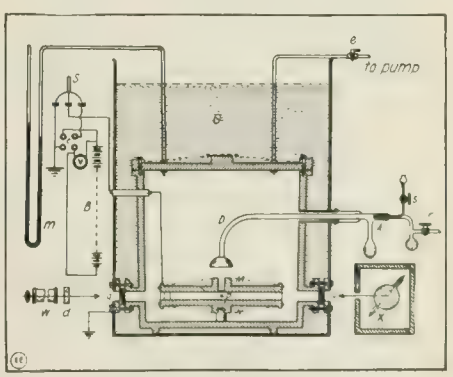


Fig. 6.—Sectional View of the Millikan Apparatus For Measuring the "Electron." Temperature Is Kept Constant by Oil Tank G. Oil Spray Is Produced by Atomizer A, the Droplet Entering Between Plates M and N, Thru Tiny Hole In Top Plate. Light From an Arc Lamp Passes Thru Heat Absorbers W and D, Enters Thru Glass Window g, and Illuminates Droplet P. Additional Ions Are Produced About P, by X-rays From the Bulb X. A Special Microscope Enables Close Observation of the Droplet, As Prof. Millikan Explains In His Work—"The Electron."

The second advance is the proof of the divisibility of the atom, a proof which grew out of the discovery of X-rays. Let me tell you how. If you have here two plates (Fig. 1.) with an electric field betwen them, and nothing else but a monatomic gas like *helium,* then it is found that when the field is thrown on the helium is perfectly stagnant, but when a beam of X-rays is shot between the plates *some of the molecules become electrically charged and begin to jump, some of them toward the upper plate and some toward the lower plate,* where their presence can be detected by an electrical measuring instrument. What does that show? It shows that the thing which we call an atom has electrical charges as its constituents; and the history of the last twenty years in physics has consisted pretty largely in determining what are the properties of these electrical constituents.

The third is the discovery of radio-activity, which occurred just a little after the discovery of X-rays. And here again we found matter doing things we had never dreamed it was doing viz: shooting off from itself both negatively and positively charged particles, the negatives with a speed which may approach close to the velocity of light, 186,000 miles per second, and positives with a speed of one-tenth of that, or 18,000 miles. The fact that such speeds could be imparted to projectiles of any kind was undreamed of twenty years ago.

The fourth discovery that I wish to mention is the discovery of the atomicity of electricity, the proof that the thing we call electricity is built up out of a definite number of specks of electricity, all exactly alike, and that what we call an electrical current consists simply in the journey along the conductor of these electrical specks, which we may call with perfect justice definite *material* bodies. Now, I can give you in just a word the proof of that statement. There are half a dozen ways in which it could be approached. I will mention the one with which I am most familiar, because it is the particular proof which we worked out at our (University of Chicago) laboratory.

We took these plates with a field of 10,000 volts between them, with a little hole in the top plate, and we blew an oil spray above the top plate so as to get an electrically charged body just as small as we could, for we expected that the frictional process involved in blowing the spray would charge the drops, which it was found to do. (Fig. 2.) We let one of those drops come into the space between the plates and then moved it up and down by an electrical field, throwing on the field as it came close to the bottom plate, and throwing it off as it approached the upper one, and so we kept that oil drop going up and down between the plates, in the hope that it would capture some of the ions which we knew existed in the air, put there by radium or other agencies. The drop met our fullest expectations as a police officer capturing ions frequently and signaling the fact of each capture to the observer by the change in its speed in the field.

For the oil drop is an electrically charged body, and in a given field it moves with a definite speed. If, however, it captures an ion, its charge increases or decreases, and hence its speed increases or decreases. If the charges on ions are all alike, then we can only get one particular change in speed. If the charge that is already upon it, put there by the frictional process, is built up

(*Continued on page* 643)

NOW FOR THE ELECTRICAL RAZOR.

We are truly living thru an electrical age and there is a never-ceasing demand for new inventions driven by electricity. Here we are offered the electric razor that is said to remove the beard, without the pull, with a smoothness that cannot be equaled.

The Electric Razor Is the Newest Novelty. Its Plug Terminal Fits Any Lamp Socket. It Combines a Massage and a Smooth Shave At the Same Time. It Actually "Cuts" the Hair Off.

To the busy man, when time means money as well as to the man who cannot shave himself, this machine will appeal. It can be used without electricity, the same way as any razor.

The construction of the electric razor is very simple: A vibrating motor is stationed in the handle wound with enameled wire which is water-proof. The head is made of the best treated steel.

With the new electric safety razor the blade vibrates 1,200 times a minute *and actually cuts the hair* instead of pulling; and there is no need of the necessary side stroke that must be used in the common safety razor. The new razor has the effect of both a shave and *massage,* leaving the face with the most pleasant feeling that is not possible without the vibrating effect here produced.

To shave with the electric razor is the same process as shaving with any razor, except that you connect the cord with a light socket and turn on the switch when beard is lathered. The device runs with alternating-current, but the makers are perfecting a direct-current type.

JAPANESE SUPERSTITIONS AND THE TELEPHONE.

The Japanese, like many Americans, believe there is luck in certain numbers, and are willing to go to great lengths to gain the protection of these lucky symbols.

A single figure telephone in Tokio sells for from 800 to 1,000 yen ($390 to $490) a year. The luckiest number in the estimation of business is eight, because the character for it spreads downward and suggests the idea of gathering prosperity. Number 753 is also believed to be a lucky number, because children are presented at Shinto shrines on their third, fifth and seventh birthdays. Indeed, odd numbers are lucky. Three-figure numbers are not objectionable, if they are as easy to remember as 123 or 555.

The most unlucky numbers are 42 and 49, because the former may be pronounced "shini," which means "to die," and the latter may be pronounced "shiku," which means "death" and "suffering." Therefore, it is said that those numbers are avoided by individuals and generally taken by government officers, schools, police stations, and other invincible institutions.

You Sign Your Name on This Time Clock

A new electric time clock recently patented and now being placed on the market is illustrated herewith. The invention in question is a new time recording device that "cannot be beat." We are all accustomed to seeing the big clocks with their hundreds of card racks, in working establishments, these racks being an entirely cumbersome and unnecessary item. Besides, who hasn't heard of the numerous ideas and schemes employees evolve to defraud the company by having a friend ring up their number for them.

Then again big corporations keep tabs on their hundreds of workers, whose time is only a small consideration, yet allow the big directors and various officials to come and go at leisure, whose time may be many times more valuable and expensive to the firm!

Therefore, it is of value to know and be sure that important persons in your employ are punctual and arrive on time to transact your business, otherwise many an important order may be lost by an executive being late.

Wherefore we have the "Signograph" perfected by Mr. H. Hartman, of New York.

The machine itself is of small and attractive construction taking but little space on the wall or desk, measuring only 9 inches long, 7 inches wide and 3 inches deep. It is made entirely of metal, black enameled. Its heart is an eight-day clock

The Time Clock That Can't Be Beat. It Automatically Registers the Day, Hour and Minute That You "Sign" Your Name. It Can Be Electrically Connected to Store Doors, Etc.

movement attached to the mechanism.

Attached to the clock is a large wheel on which are the figures for the hours of the day and night. Arabic figures show the time A. M. and Roman figures designate the time P. M.

Being named the "Signograph," it means exactly as its name implies. In the front of the device is a small glass door. When the person desires to record time, he or she simply opens the door. Immediately the door is open a record is made inside the machine by a device on the door hinge which presses the paper against the type wheel containing the hour numerals; then the person signs his or her signature, as the case might be, closes the door, moves the paper up and the trick is done! .Very simple and yet effective, as a written evidence is obtained of the party being on time.

The eight-day clock movement can be wound from the outside, while the machine can be opened by one possessing the key for the purpose of changing records; these consist of a continuous strip of paper 3 inches wide, which shows at a glance the signatures thereon with accurate *day, hour* and *minute* printed opposite each signature.

The instrument has no complicated mechanism to get out of order and is constructed along lines that avoid every shock or sudden vibration which could affect the clock. Not only all this, but the clock can be fitted with an automatic electrical device that will register the time when a person opens or unlocks the door of an establishment, thereby showing the exact hour and minute at which the responsible party arrived.

Taking the device as a whole it appears to be a 100% efficiency machine, and a necessity to almost any class of business. By referring to the photos a clear idea of the entire mechanism may be obtained and will prove that this machine can't be beat.

WIRELESS COURSE AT UNIVERSITY OF WISCONSIN.

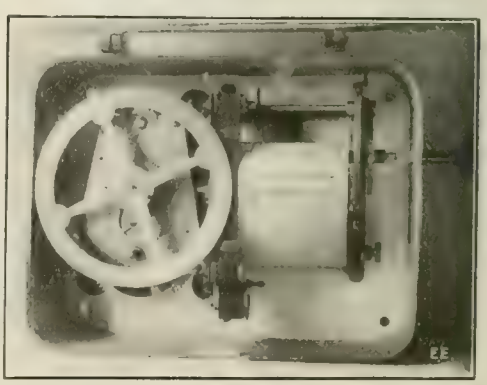
Wireless telegraphy, with special application to war service, has now been made a regular course at the University of Wisconsin. A number of students worked independently in the university radio station last year and during the summer session a course for operators was given, but university credit for the work is given for the first time this year.

The radio station at the university is one of the few to be left in operation after the declaration of war because war research is being carried on with the station apparatus. Lieutenant Taylor, radio communication superintendent at the Great Lakes naval training station in Illinois, recently visited the Wisconsin station and made a number of tests. An officer from the naval station will be in the university this year to carry on tests with the Great Lakes station.

The mathematical theory of electricity and magnetism as related to wireless telegraphy will be given careful study in the new course as well as a detailed study of the apparatus itself. The students will also have a chance to become expert operators.

A review of general physics, a special study of transformers and oscillating currents and their application to sending and receiving apparatus, as well as a careful study of special forms of sending sets, will be included in the work. The course will continue thruout the year.

It is estimated that this year's business in electric ranges will be in the neighborhood of $3,000,000.



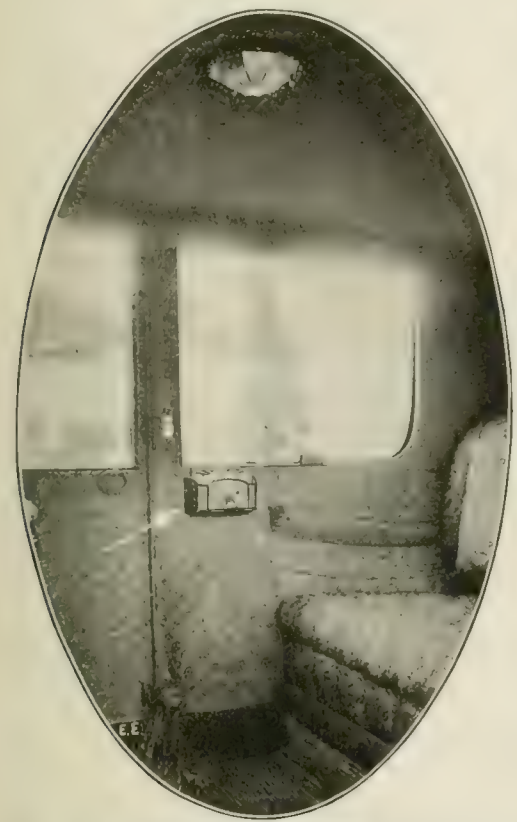
Interior of New Time Clock, Showing Record of Signature on Clockwork Driven Paper Roll and "Time" Typewheel At Left.

Novel Applications of The Dictograph

PEOPLE will not cease wondering at the seemingly marvelous and uncanny way conversations are picked up by the Dictograph, the original supersensitive microphone.

In its secret service adaptation, it is used by the U. S. Department of Justice, the Army and Navy, and governmental, state and municipal police authorities for securing the evidence wanted, when any other method would have failed. Numerous cases might be cited, the one most prominent in the public eye being the recent dynamiting cases of the McNamaras.

Then again, in business its application in interior inter-communication has proved a big help. By the aid of a "master station" a busy executive is able to hold instant communication with his stenographer, superintendent or factory, hold conferences, know exactly what is going on and never have to leave his desk; or he may walk around the room, file papers, etc., and still be able to converse with whoever is at the other end just as if they were in the room.



The Loud Speaking Telephone or Dictograph Has Found Its Way Into the Motor-Car World. Many of the Best Cars Are Now Regularly Equipt With This Convenience (See Arrow), Permitting One to Give Directions to the Chauffeur Without Moving.

But by far the greatest boon to mankind of this invention has been its adaption in aiding deaf people to hear, thereby making them more efficient and useful, and also lessening the chance of accidents.

To church and theatregoers it has also proven of great merit—heretofore deaf people could only see the show or sit dumbly in church, but by this application of the dictograph they are now enabled to secure seats which are equipt with receivers adjustable to each individual and hear everything that is said, not to mention the enjoyment of the music and singing.

In the first illustration may be seen the very latest application of the microphonic principle—to help Uncle Sam win this war with flying machines. Heretofore the training of men for the flying corps and their work on the battlefield has been hampered thru lack of adequate means of communication between the pilot and observer—thereby necessitating them to return to the ground before they could give any detailed or elaborate directions to one another or make changes in their plans.

This new system consists of a special headgear which is strapt over the regular helmet. In the back of the same is set a dictograph so that it is always in the vertical position; from this a tube leads downward to a specially constructed mouth-piece, to be strapt in place over the mouth.

A stop-cock regulates the sonority of the voice which is allowed to reach the dictograph—a special cable is run between the two seats and to which both operators attach their plugs. It is believed that this method will supersede all previous efforts in this line. Those who have never been up in a flying machine of modern type, which speeds along at a velocity of from 60 to 120 miles per hour at times, have no real conception of the physical action on the aviator. His face is often distorted by the terrific air pressure—his cheeks are pushed inward until they are hollow. And oftentimes he can just barely speak, owing to the severe cold, which fairly petrifies the skin and flesh. This condition was mentioned to the writer by a member of the Royal Flying Corps of Canada.

The interior view of the limousine shows the dictograph serving as a means of communication between the occupants of the car and the chauffeur, without the necessity of anybody moving their position or holding speaking tubes. Just press the button—talk in a natural tone—and the chauffeur hears every word clearly and distinctly. This type of equipment will be found on almost every car of note this season, among which may be named the following representative ones: Packard, Cole, Cadillac, Hudson, Pierce-Arrow, Winton, Chalmers and Willys-Knight.

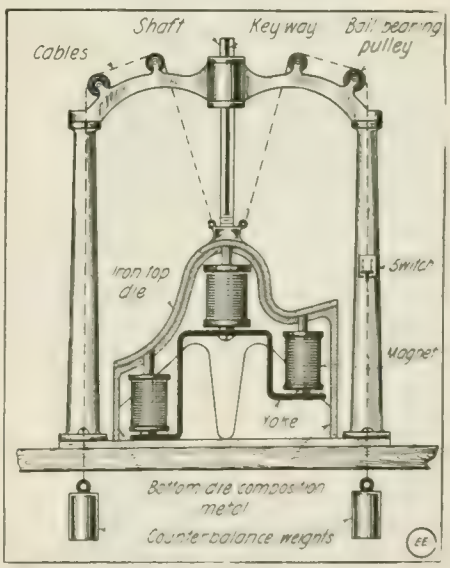
Perhaps the most interesting and novel application of the dictograph is the installation in a very popular Broadway rendezvous—the "Palais Royal." In the ballroom, where diners and dancers wile away their hours, the management has had placed around the pillars carefully concealed horns. Near the orchestra, a number of special dictographs are placed, with wires leading to the cabaret performers' dressing rooms. When the music commences it is carried to the dressing rooms and the artists sing into transmitters which are connected with the horns in the dining room, causing the singing to come from a seemingly mysterious source, much to the amazement of the patrons.—GEORGE HOLMES.

U. S. Aviators Are Being Supplied With the New Dictograph Here Shown, for Carrying on Conversation With a Second Officer, While in Flight. The Engine Noise and Wind Make It Difficult to Talk Otherwise.

A "MAGNETIC" HAT DIE.

By John P. Buckley.

The present hat-making machines are operated by hand and require a very strong and skilful man to operate them. I show herewith drawing of a "magnetic" hat die which dispenses with the press entirely. It is composed of the usual two members, the lower and upper die. The lower die is made of non-magnetic metal and is provided with one or more magnets, the respective poles of which pierce the frame of the die and even out smoothly with the outer surface; the upper die being of iron, when placed over the lower die acts like an armature, and, in becoming attracted, presses and heats the material to be shaped.



A New Hat-Die in Which the Moving Form is Pulled Against the Fixt Plate by Means of Electro-Magnets.

A girl may operate several of these machines or dies at one time.

OUT-LEVITATING BACHELET!

While in Manchester, England, recently I came across considerable local enthusiasm for gas-driven vehicles. I heard of one optimist who is working night and day to solve the problem with "comprest gas." His efforts, however, pale before those of a super-gas merchant who believes in the flexible holder on the roof; the chief plank in his platform is that when the holder is full there is a levitating effect which takes a lot of the weight of the vehicle off the tires and increases their mileage. Shades of Bachelet, what next!

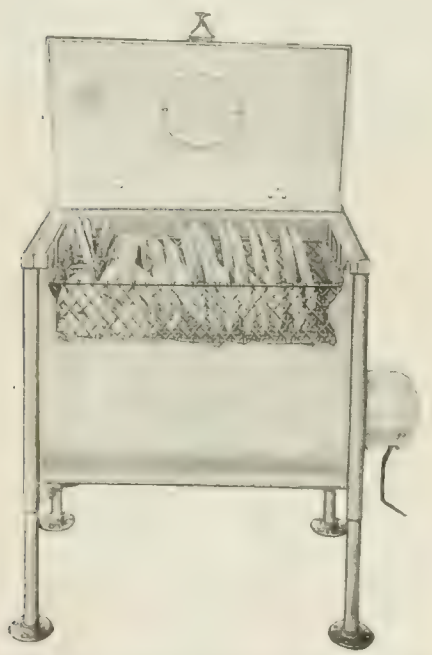
DISHWASHING BY ELECTRICITY.

Who wants to wash dishes? Answer—Nobody. Therefore and hence we have with us today the electric dishwasher here portrayed.

Under the basket containing the dishes as shown in the picture, is a square shaft to which are attached propellers or scoops. This shaft is connected directly to an electric motor by means of a spur gear. As the shaft is revolved at approximately 600 revolutions per minute, the water is thrown with great force upward and around the dishes in the basket. Every surface is cleansed and every trace of food particles, grease and accumulations of any kind removed. Breakage is practically impossible for the reason that the hot water comes in contact with all surfaces, inside and outside, at the same time and the expansion is fairly equalized.

There has been considerable agitation in recent months concerning the dangers of careless dishwashing and authorities agree that the only thoroly safe method is the machine method where practically boiling water can be used.

This electric dishwasher is of very rigid construction. The body is 24 gage steel—all joints and corners are welded—the legs are standard 1 inch wrought iron pipe, securely welded to the angle iron frame work—the propellers are riveted to the shaft and all parts are rust-proofed. The electric motor is enclosed with the housing

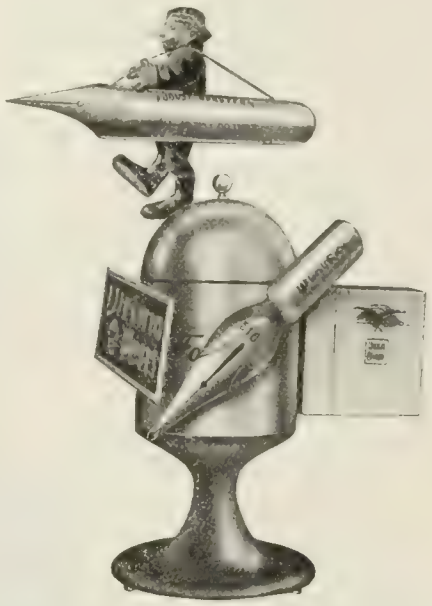


Mother and the Girls May Now Rejoice, for Here's the Genie That Washes the Soiled Dishes By Electricity. And It Never Wants a Day Off.

which the picture shows, protecting it from splashing, and also safe-guarding the children. The finish of the machine is baked-on white enamel.

A MYSTIC WHIRLING SHOW WINDOW ATTRACTION.

A distinct and startling novelty shown at the recent Electrical Show held at New



Pens, Boxes, Figures, Everything, Stick to This Mysterious Cylinder and Whirl Around It in a Fascinating Manner.

York was a whirling display which attracts electrically every variety of small object. Toy automobiles tour its circular surface, miniature yachts ride its metal sea with even keel, handkerchiefs, papers of pins, everything it is possible to purchase in a ten-cent store, cling to its electrified surface and attract the eye of the passers-by. H. J. Herberts, inventor of this selling device, placed his first contract with a German firm just before the war. As a result the first 10,000 made were confiscated by the German Government for the brass and copper they contained, and the inventor had to come to America and begin all over again. The machine is fully protected by patents.

This remarkable advertising device consists of electrically driven apparatus inclosed in a plated metal jacket and dome, upon which the goods are made to revolve without any visible means of suspension while the external part of the apparatus is quite stationary. No hooks or wires of any sort are employed. The approximate dimensions of the device are 24 in. high and 9 in. in diameter. Articles of unusual shape take peculiar lines of travel about the smooth metal cylinder, rolling over and over as they go.

RADIO TELEPHONY IN JAPAN.

The Institute of Radio Engineers held a meeting on Wednesday evening, November 7, in the Engineering Societies Building, New York, at which Mr. Eitaro Yokoyama, engineer of the Ministry of Communications, Tokyo, Japan, presented a paper on "Some Aspects of Radio Telephony in Japan." The paper contained an interesting summary of the little-known work which has been done in this field in Japan.

WIRELESS LOST BATTLE.

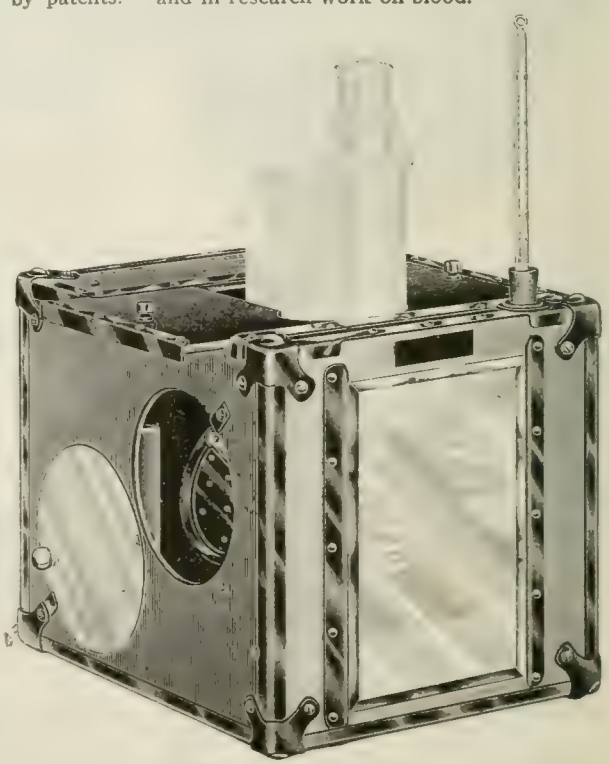
Great events turn on very small incidents. It is now given out that the reason the Germans were defeated in the battle of the Marne was largely because one of the commanding officers did not know enough about wireless telegraphy to know that the big instrument on Eiffel tower in Paris was picking up his messages as fast as he sent them back to German headquarters. As a result the French army was enabled to make preparations which turned the tide of battle against the Germans on the Marne. The German general was an expert fighter but he had not kept up with the modern progress of inventive genius in the development of wireless telegraphy, and consequently because of this lack of knowledge it is now given out officially that the battle was lost to the Germans. (*A very pretty tale, but incredible.*—EDITOR.)

THE ELECTRIC MICROSCOPE INCUBATOR CLEVER INVENTION.

For those desiring to make a special study of Micro-organisms at blood temperature for any length of time, there is now available a specially constructed incubator, in which the entire microscope may be placed. The illustration shows how this is accomplisht. To place the microscope in the incubator the two sliding doors on the top are pulled out and afterwards pushed back until they fit tight against the microscope. Both sides are provided with hand holes, which enable the operator to manipulate the microscope in the ordinary way. When not in use the hand holes are closed by metal slides.

The Incubator is made of insulating material and has a removable plate glass front. The heating element consist of special wire units, distributed inside the cabinet. It is controlled in the usual way by a clever adjustable electro-thermostat.

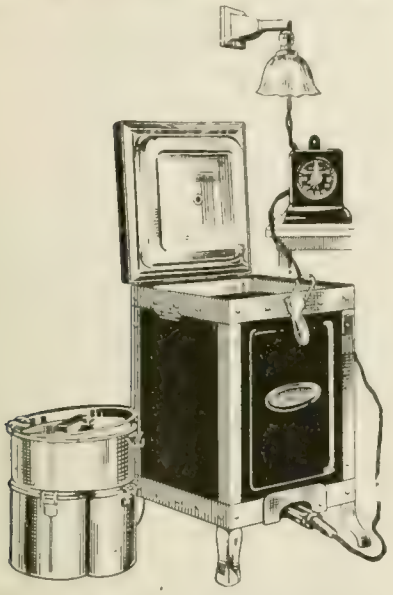
This Incubator is particularly well adapted for universities and research laboratories. It is used to advantage in watching developments of embryos of animal parasites and also in watching the growths of normal and abnormal tissues. It is convenient in bacteriological and zoölogical research work and in research work on blood.



An Electric Incubator for Maintaining the Entire Microscope at a Constant Temperature. A Necessary Refinement Where Live Organisms or Tissue are to Be Studied.

NEW ELECTRIC STOVE RESEMBLES "FIRELESS COOKER."

A new electric stove built on the order of the heat-retaining "fireless cooker" is shown in the illustration herewith and



The "Fireless Cooker" Principle Is Incorporated in This Electric Stove. You Start with 620 Watts for a Few Moments, Then Switch on the 40 Watt Heater, the Latter Doing the Real Cooking.

operates on 40 watts, (same as your lamps).

Place any food you wish in the compartment, and close the cover. Set the clock for a few minutes current, to heat up the calorator. At the expiration of that time the clock will turn off the 620 watt heater and turn on the 40 watt heater. The cooking heat will then remain at cooking temperature until you wish to use your food.

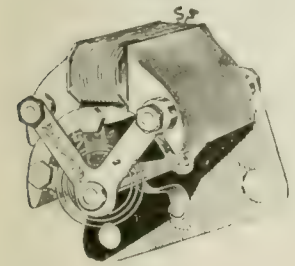
You can cook an average meal for less than two cents, its makers claim.

These new electric cookers are finished in blue enamel with nickel trimmings and are made of iron; lined with heavy gage aluminum. Each cooker is provided with one 3-quart circular kettle and two 2½-quart semi-circular kettles, all made of heavy gage aluminum. Thus you cook a whole meal—meat, potatoes and two vegetables—at one time.

The heat calorator in the bottom of the cooker is made with two heating elements. One consumes 620 watts (same as an electric iron) and the other 40 watts (same as one electric light).

AUTOMATIC LIGHT CONTROLLER FOR FLIVVERS.

The automatic light controller here shown is placed on the dash under the hood and requires no adjustment or manipulation by the operator of the car.



An Automatic Controller for Regulating Light from A. C. Dynamo System of the Ford Car.

By means of a moving armature which is automatically pulled under a magnetized field as the car speeds up and dropt out as the speed decreases, the lights are kept practically constant thruout the range of speed of the car. It is intended for use on Ford cars in which an alternating current magneto is used.

The controller operates on the impedance or reactance principle. The field is wound with suitable magnet wire and connected in series with the circuit of the magneto which furnishes current to the lamps. The current of the magneto passing thru this winding energizes the field magnetically in direct proportion to the strength of the magneto current which is governed by the speed of the car. The armature rotates in this magnetic field and is so adjusted that when the speed of the car is below ten miles per hour the field has not sufficient strength to attract it and consequently no impedance is offered to the current, and the lights burn at full voltage and candlepower. As the speed of the car is increased the magnetic strength of the field is increased, and the armature is drawn under it in exact proportion to the increased speed and voltage. Impedance is now set up between the field and armature in the same proportion, which reacts on the current and voltage generated by the magneto and keeps the voltage and candle power of the lamps practically constant thruout the range of speed of the car, as the greater the speed the greater the magnetic strength of the field, the greater the movement of the armature under the field and the greater the impedance set up between the field and armature.

SERVICE OVERSEAS!!!

Electrical men are wanted for early service overseas. The men in the front line trench need the help and coöperation of skilled men back of the lines, and electrical men are wanted at once for the Enlisted Ordnance Corps, National Army.

Uncle Sam is calling on our trade to come across and help his fighting men. There is a lot of work to be done over there, and the call has gone out for electricians and electrical men between the ages of 18 and 40 who want to do their bit, and who know their job.

Modern war is a tremendous business, and the army that wins is the army which has the best equipment and the best men. The men are over there now—they are ready to go ahead, but they still need experts in our line to repair and maintain their equipment. There is a fine chance for every man who wants to help.

Write to the Chief of Ordnance, War Department, Washington, D. C.

THE ELECTRIC TEA WAGON AWAITS! YOUR LADYSHIP.

It is often desirable to have an electric heater for teapot, chafing dish or toaster at the hostess' hand and to meet this requirement we have the new electric tea wagon here illustrated. At least two devices may always be heated, such as an electric percolator and a chafing dish or toaster.

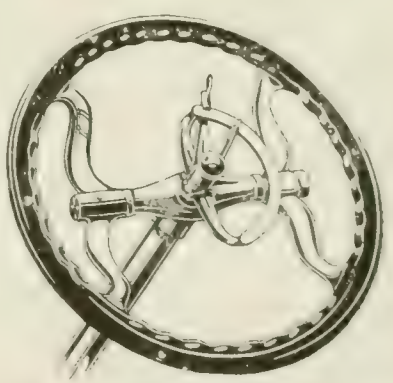
The designer has incorporated a feature of considerable merit in connection with the wiring of this electric tea wagon, in the form of an adjustable table reel installed under the lower shelf. This is a spring-actuated device, operating as simply as a spring roller window shade, and it carries ten feet of silk covered lamp cord with an attachment plug at the end. When the tea wagon is not in use this attachment plug may be withdrawn from the wall receptacle, whereupon the adjustable reel will automatically take up the slack so that it does not trail on the floor or be wound up and stowed. On the other hand, a slight pull on the cord will extend it, allowing it to unreel to its full length whenever desired. There is no strain on the cord while it is connected, as the table reel locks automatically in any position to which you may desire to set it, and can be released by a touch of the finger.

Yes, It's Here! The Electric Tea Wagon Simply Had to Come.

ELECTRICALLY WARMED AUTO STEERING WHEEL.

This electrically warmed hand wheel for autos may be applied to any car and it operates practically without cost, drawing but a slight amount of current, about as much as does one of the headlights from the storage battery when in use. When not in use there is nothing but the switch button to show that the heating attachment is present—as all the mechanism is embedded in the composition of the wheel with the wires self-contained within the steering column. The wheel is made either in Bakelite or Condensite.

To outside appearances the rim is identical with the plain model steering wheel, for the reason that the heating coils are self contained in the composition. The simple pushing of the small button located on the spider of the wheel turns the heat on or off. The heating wires are cast within the rim, concealed from view. Thus the driver is not conscious of the heating feature until he presses the button, when the wheel begins to warm his hands. This steering wheel is one of the best models yet developed. It always retains its hand-



A New Electrically Warmed Steering Wheel Which Has the Heating Wires Embedded in the Moulded Rim.

some appearance, not becoming shabby in a few months as varnished wooden types are wont to do. It operates from the car battery.

The Chemical Exhibition at New York

By ALBERT W. WILSDON

THE exhibits at the Third National Exhibition of Chemical Industries, held at Grand Central Palace, at New York City during the week of September 24, 1917, was very interesting and instructive both for the layman and the engineer.

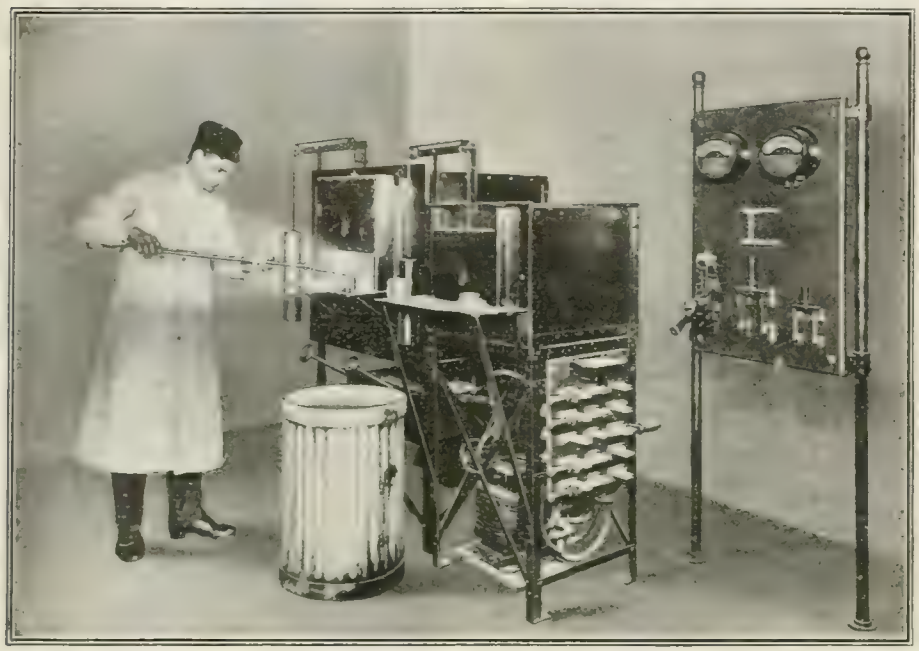


Fig. 4. Tool Hardening with Modern Electric Furnaces. The Furnace at the Right Is Specially Adapted for Hardening Carbon Steels and Pre-heating High Speed Steels. The Furnace at the Left Is for Hardening High Speed Steels. The Electric Furnace Is Ideal for All Such Work as the Heat Can Be Very Closely Regulated.

Electricity of course, played a very conspicuous rôle, and many new appliances were exhibited which had been improved upon by its use.

Among the exhibitors displaying electric devices were the following:

The Anaconda Copper Mining Company exhibited products showing various steps in the reduction of copper, commencing with the Butte ores, to the commercial refined copper shapes such as ingots, wire bars, slabs, cakes, etc. Also an interesting and extensive exhibit of the important by-products obtained by the *electrolytic refining* of copper, such as copper sulfate, nickel sulfate, white arsenic, selenium in all its allotropic modifications, tellurium, silver, gold, platinum, and palladium.

The Condensite people displayed molded electrical insulation as applied to automobile starting, lighting, and ignition apparatus, moulded commutators, high tension insulators, U. S. Navy wireless insulators and lamp sockets, electrical condensers, and miscellaneous insulation, condensite molding preparations, impregnating enamels and cements, molded condensite as used in disc phonograph records, moving picture machines, vending machines, fire extinguishers, etc.

Then there was a complete 5 H.P. industrial steam plant in actual operation. This miniature plant embodies an automatic boiler-feeding system, auto lifting and non-return steam traps. A coil kettle is heated to a definite temperature by the boiler, and the condensation is returned to the boiler—100 per cent efficiency is claimed.

A new *electrostatic separator*, Fig. 1, was demonstrated, and in which concentrations and separations of mixed ores are produced by *static* electricity. This device embodies an electrically charged electrode as shown, which serves to attract all the good conducting ore to one side while the poor conductors are past over the drum to a different container.

A complete line of pyrometers, including both recording and optical types was shown, the latter being of special interest, possessing both accuracy and simplicity. In connection with the recording instruments a red, white and blue light system of indicating variation, high or low, of the furnace temperatures from a fixt value was exhibited. Apparatus for determining the conductivity of electrolytes was shown, including the Vreeland oscillator for producing a high frequency E. M. F. of pure sine wave. The new design of the *Burrows permeameter* for magnetic measurements, and a useful type of *hydrogen electrode* was also demonstrated.

Technical thermometers of all descriptions were there, including thermometers for laboratory and research work, and for acid manufacturers, also the *Pentane* and *toluol* thermometer, for low temperatures, the toluol to minus 100 deg. C; the Pentane to minus 200 deg. C.

An eastern electrical instrument company exhibited a new line of pyrometers and electrical precision instruments. A very interesting booklet was distributed by this concern which contained considerable information regarding high and low temperatures. Fig. 2 gives a very instructive curve of the estimated number of laws and facts known experimentally, which was taken from this booklet. In this chart temperature elevation is indicated by the height of a vertical line, and the makers have, to an approximation, represented by distances measured to the right of this line the number of facts and laws of matter about which we have gathered true experimental evidence. Thus there is obtained a curved line bounding the *Region of Experimental Evidence*. All outside this curve belongs to the field of imagination and speculation, and may properly be called the *Region of Pure Surmise*. The former region is large when compared with the inner small *Region Known To The Ancients*—which the philosophers of antiquity could have drawn to represent the knowledge of their day. The *Region of Pure Surmise* extends beyond all assignable limits, and investigation of this Region is an aim and problem of modern industrial research. Its investigation is possible because a very large portion of it lies within the limits of producible and measureable temperatures.

The same concern exhibited one of the very latest adjuncts to science in the form of a *high-frequency induction electric furnace*. This device is shown at Fig. 3, and was developed by Prof. Northrup of Princeton University, for use in special work. The outfit illustrated at Fig. 3 is of the vacuum type with a rating of 20 kilowatts.

This high frequency induction furnace presents a radical departure from usual furnace practise, and embodies the first employment of *oscillatory* currents for the generation of heat and production of temperature. By reason of the highly effective induction possible without the interlinkage of a magnetic with an electrical circuit, currents can be set up in the containing crucible in the case of a non-conducting melt, or in the melt itself if the same has sufficient conductance to permit the flow of currents. *No iron is used.* Thus it is possible to raise the temperature of a melt in a crucible until its resistance becomes low enough to permit the generation of heat in the substance itself (as in the case of melting glass), after which the temperature producible is limited only by the durability of the insulation and refractory container.

Since this furnace operates by induction, conditions of the melting chamber may be controlled perfectly. Thus it is possible to produce temperatures exceeding 1600° C in a partial vacuum or pressure, with any conceivable atmosphere, and if desired, without the contaminating influence of carbon. The furnace works on a two-phase commercial circuit (60 cycles frequency), 220 volts, with balanced load at unity or slightly leading power factor.

Time was when the tool-maker and ma-

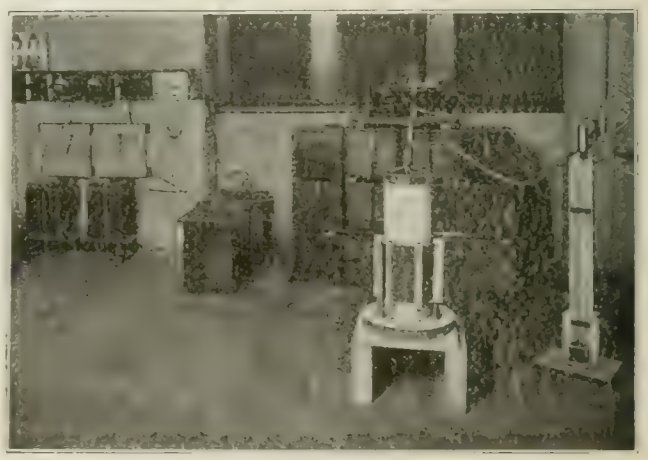


Fig. 3. The Very Latest Thing in Electric Furnaces—the Northrup High Frequency Vacuum Type. This Outfit Is Rated at 20 Kilowatts. No Iron Is Used and It Operates by Induction.

chinist thought that the gas furnace represented the last word in such devices, especially for tool hardening and treating. But now the electric furnace has come to the front. The furnace shown at Fig. 4 is being used to harden tools, reamers, taps, etc. It is also being used for hardening precision tools where it is required to produce a number of different pieces of steel

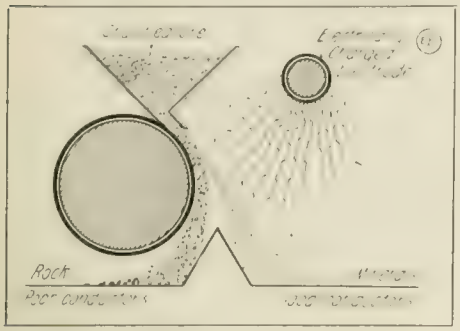


Fig. 1. Magnetic Ore Separators are Quite Common—But Here Is an "Electrostatic" Ore Separator. The Charged Electrode Attracts the Good Conductors So That They Fall Into a Separate Compartment as Shown.

to do duplicate work. Another use to which this furnace is put is the hardening of ball-bearing thrusts. It is widely employed also for the proper tempering of steel magnets, particularly small ring-shaped magnets such as used in telephone receivers, compasses, and other precision and measuring instruments. The electric furnace is susceptible of very accurate control, the heat being readily regulated to within a few degrees of the desired value. With improvements in design these apparatus have been brought to a high state of efficiency and cost no more to run than other types.

Recording thermometers, pyrometers and temperature regulators held the interest of many. A new development was shown in the "multipyrograph" for recording six different temperatures on one chart, employing only one electric galvanometer.

Electrical apparatus of particular interest to chemists were shown, including motors, starters, oil switches, circuit-breakers, meters and transformers. A laboratory line of apparatus was also exhibited including electric stoves, hot plates, water heaters, fans and air pumps. A number of Bakelite-Micarta gears were shown. Bakelite-Micarta is the only non-metallic gearing material that is self supporting and in most cases neither bushings nor flanges are needed. A Thury regulator was shown, which regulates the temperature of electric furnaces automatically.

The sponsors of "Bakelite" displayed numerous forms of Bakelite products, moulding mixtures, varnishes, lacquers, enamels, cements, transparent and colored, in sheet, rod, tube and special forms.

Dr. L. H. Bakeland, the well-known inventor of Bakelite, and gaslight photographic papers, and member of the Naval Consulting Board, gave a very interesting lecture regarding the dystuff industry under the heading of a paper "The Future of Chemical Industry in the United States."

Exhibitors of American made dyestuffs were the center of attraction and many remarkable shades of colors were shown which compared favorably with those which were imported from Germany before the war. Indeed, the exhibits of the large manufacturing concerns demonstrated how this country had past from a position of absolute dependence upon foreign sources of supply for both the intermediate and finished dyestuffs to one of potential independence, as regards both, in less than eighteen months! To-day there are more than *ninety* manufacturers of crudes and

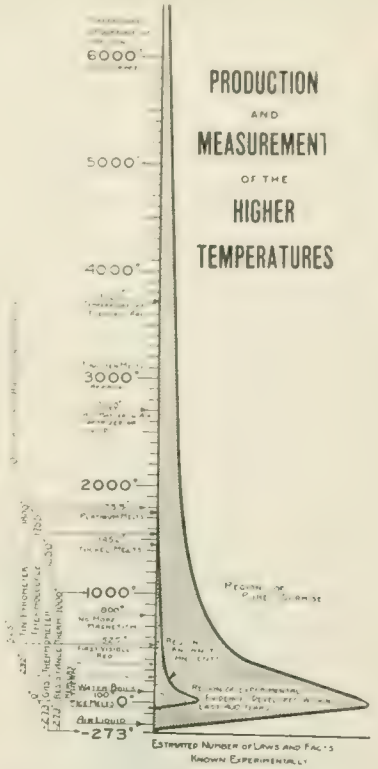


Fig. 2. An Interesting Temperature Chart Which Shows Graphically All We Know About This Subject. The Shaded Area Indicates Relative Known Facts at Each Temperature. At 6,000° C. We Know But Little, as Becomes Evident.

intermediates, and about *eighty* manufacturers of artificial products.

War Address by A. I. E. E. President-elect, E. W. Rice, Jr.*

(EXCERPTED)

IT GIVES me great pleasure to meet you here to-night and to be thus introduced as your President-Elect. I thank you, and thru you, all the members of our great Institution, for the honor which you have conferred upon me in selecting me to be, for a time, your official leader and chief servant. I hope I may have the strength, the ability and the opportunity to render such service as to justify, in some measure, your confidence. I fully appreciate that, with such a great honor, is coupled an equally great responsibility and I value the position as an opportunity to be of service to you, and thru you, to our country.

No body of men can get together at the present time without soon discussing the subject of the war, which is uppermost in everyone's mind.

The war is the one dominating factor in the world life and thrusts itself before our thoughts whether we wish it or not. We are in the war at last and will remain in it to the end. Whether it shall be a bitter end or a bright end will depend largely upon ourselves, as it is now our war.

It has been stated many times that modern war was largely a question of mechanics and engineering, a statement with which we must all agree. It is self-evident that engineering must, therefore, take a leading and dominant position in the war work. Now the electrical engineer stands for about the latest thing in engineering development; his activities embrace practically all other fields of engineering, being, so to speak, the last word in engineering. The electrical engineer must, therefore, realize that this is his war in a very personal and particular sense.

War calls for supreme sacrifices and the deepest devotion, but it also demands something more difficult to give, and that is ***work***. War may be said to be the personification of work, not only individual work, but especially organized and disciplined work,—disagreeable, dirty, heart-breaking, backbreaking, nerve-racking work, but always work. No nation of loafers ever won a war. Other things being at all equal, that nation or people who are willing to work the hardest will surely win the victory. Now I wish to point out that the enemy we are fighting is recognized as the most industrious organization in the world. Our enemy has prepared for war for fifty years and has been working with ever-increasing energy ever since the war started three years ago. We made no adequate preparation during all this time and therefore started with a fearful handicap of lost time and lost opportunities. We must not delude ourselves that our enemy is exhausted, but remember that he has the advantage of a flying start. We must accelerate at an incredible rate if we are to get our war-motor going fast enough, soon enough to catch up.

Now, properly understood, the fact that no *single great invention* is likely to be made which will win the war, is no cause for discouragement. It does not mean that there will be no improvement, no new inventions, no new methods devised and put into effect. It simply means that we must not wait for the miracle which will never appear, but get to work and energetically take advantage of all present knowledge. We must survey the field, get at all the facts, carefully determine our plans and then proceed to put them into practical execution.

Take for example the matter of shipping. This perhaps presents the greatest immediate problem of the war, frightfully complicated as it is by the submarine. I feel sure that it can be successfully solved, if we are content to solve it by the simple, common-sense methods used by engineers and successful business men in the ordinary course of business. The problem must first be carefully investigated, all available data quickly obtained and checked, and all new conditions considered, after which a broad-gaged, well considered plan, or plans, can be formulated, criticised and then put into effect.

Of course it is elementary to say that we must provide shipping in enormous quantities to replace that destroyed and to provide for increased demands. It is evident that time is the essence of the problem. We must, therefore, build the greatest tonnage in the shortest time. The ships must be manned and navigated to their destination and the most efficient methods provided for docking, unloading and loading.

(*Continued on page* 648)

* Mr. Rice is president of the great General Electric Co., and his suggestions are of particular significance at this time of national stress.

"TOO LATE"

By CHARLES S. WOLFE

The Story of a Successful Relay That Was Unsuccessful

THE clock over my instrument table gave a reading of 10:30 P. M. The air had been particularly dead all evening and I was a trifle bored. I pried my ears loose from the *Holtzer-Cabots,* laid them (the 'phones, of course, you simp) on the table gently, and arose to throw my lightning switch.

But I didn't quite get away with it. Before I reached the window I heard a faint squeak from the table. I knew who it was, all right; Jimmy Hooven, the only other amateur in town. Jimmy did his ether blasting with a full, round kilowatt, and a kilowatt at a half mile gives forth an easily readable signal, brother! It is, in fact, quite audible.

I hastily donned the receivers, threw Jimmy a trifle off tune for my ear drum's sake, and discovered that he was calling me.

As soon as my little one-inch coil had given him a wheezy "G. A.," Jimmy told me that he had just received a message from Ashheap, Ohio, for a party who lived nearer to me than to him. Would I deliver it?

Would I? The one ambition of my wireless career up until that fateful night had been to be an accessory to a real, honest-to-goodness relay message, either before, after, or during the act. Countless times I had pictured myself striding up to a door and saluting the astounded and awed householder with a matter - of - fact "Wireless message for you, sir." And here was opportunity staring me in the face.

I assured Jimmy at the rate of twenty-two of five letters each that nothing would give me more pleasure, and the instant I got my antennæ switch over he handed me this:

H. Peck,
Skunkton, Pa.
Before lighting the kitchen fire, look in the oven. Billy sometimes sleeps there.
Maria Peck.

The preamble gave the office of origin as 9 B.U.G., and as I copied it down I hastily scrawled in "Received at 3 N.U.T. Boy! That message sure looked like the real article.

Jimmy said he'd wait around until I found out whether there was to be an answer or not, and I heard him wailing C.Q. plaintively in an effort to find company as I tore off the 'phones and prepared to hop to it.

I hastily donned an overcoat, pulled a muffler around my neck, clapt a derby on my turret (I may say right here that I hatted in haste to regret at leasure), jammed the received message in my pocket together with a few blank forms, in case there was to be a reply, and hied me forth to deliver the thing to its consignee.

It was SOME evening. It was January overhead and January under foot. About two inches of damp treacherous snow covered a coating of inherently fickle ice. Little two-inch blocks of snow collided continually with my face.

I guess I had walked—or rather slid—about two blocks at a rapid pace before the great white light broke thru my shell-proof skull. Skunkton is a town of about 30,000 souls, men, women, and politicians. The telegram was addrest to H. Peck, Skunkton. For the first time it struck me that the sender might have been a trifle more explicit. A gentle hint, you know, as to what end of the city we might reasonably hope to locate H. in, at least.

I stopt and leaned against a wall. This problem merited consideration. I was sure up against it. Vainly I sought for a logical starting point. Here was a situation that called for a Sherlock Holmes.

Thinking of Sherlock Holmes brought a ghost of an idea—a mere wraith of one. Deduction—that's what this called for. Very well, I'd deduce.

Deducing at midnight in a temperature of only a few scrawny degrees above zero is rather more difficult than the uninitiated might imagine. Eventually I got the case boiled down to the following elements. Here was a telegram from Maria Peck to H. Peck. Both surnames the same. Evidently related. Sister or wife, no doubt. I eliminated the former as being unlikely and arrived at the conclusion that Maria and H. were joined in matrimony. Then, too, there was the fact that Maria was in Ashheap while H. was, supposedly at least, in Skunkton.

Now, when a man's wife is away does he hang around home? He does not. Where— It was then that I got my brilliant idea. I headed straight for the nearest saloon. Sticking my head in the door I called in loud tones, "Telegram for H. Peck."

And without a second's hesitation four gentlemen stept toward me with outstretched hands.

When I had sufficiently recovered I looked over the four that stood before me. "Good Lord," I gasped, "It can't be for all of you. What are your first names?"

And in rotation I got the following: Henry, Horace, Horatio, and Hannibal. And the worst of it was that any one of them might be the sendee.

Once again inspiration came to my assistance. "Do any of you belong to a wife named Maria?" I demanded. The quartette pleaded "Not guilty" in a breath, and I stept outside to do a little more deducing.

Under the awning, partially sheltered from the blinding snow, I made futile attempts to warm my ears, and gave the Sherlock Holmes stuff another hitch. Ah, I had it! The city directory.

Ten minutes later I handed the directory back to the bored drug - clerk, and gazed about me helplessly. The city directory was evidently a very complete work and must have been very carefully compiled. Anyhow, it listed just forty-seven Pecks whose first name began with an H., any one of which might be my quarry, and four of which were certainly not. For Horatio, Henry, Horace, and Hannibal were duly accounted for.

It looked like a war of elimination. I aroused the drug clerk from his trance and asked his advice. After some thought, he advised one of two things: use the telephone on such of the Pecks as possest the accessory, or go home and go to bed, preferably the latter.

At exactly one A. M. I stood once more on the exterior of the drug store. Out of the forty-three Pecks remaining after barring Horace Horatio, Henry, and Hannibal, I had succeeded in reaching forty, all in various stages of irritation, the last being the worst, as he had been called from the warmest bed.

But I hadn't been able to hang the accursed dispatch onto any of the forty to which I was playing Ali Baba. There remained three H. Pecks—one on Chestnut St., 1024 East; one on Center Ave., No. 4 West; and one on Brown St., 413 North. To

Jimmy Did His 'Ether Blasting' With a Full, Round Kilowatt, and a Kilowatt At Half a Mile Gives Forth an Easily Readable Signal, Brother! It Is In Fact, Quite Audible. Jimmy Told Me That He Had Just Received a Relay Message From Ashheap, Ohio, and Would I Deliver it? Would I? Well——"

those of you who are familiar with the topography of Skunkton the difficulty will be apparent on a little thought. For the benefit of those who have never been in our burg let me say that Chestnut Street is one mile from the spot on which I stood, the Brown Street address about a half a mile from that, and No. 4 Center Avenue approximately one mile and a half from the Brown Street outfit. About three miles of real icy going in the face of a snow storm, and a temperature of about ten degrees above.

I selected my first try by the simple but effective "counting out" of boyhood days. "Eeny, meeny, etc." And the lot fell on the Chestnut Street entry.

Having thus decided, I drew my overcoat more closely about me, and started.

1024 Chestnut Street was discouragingly dark. Long and continuous ringing, however, eventually brought this particular beslippered and bathrobed Peck to his very cold front door. There was about six feet of him, every millimeter of it very cold and very angry. "Well," he demanded.

"Is your wife in Ashheap, Ohio?" I inquired, politely.

"Well, you three-plyed, hog branded, triple expanding fool! Have you gotten me out of my warm bed at this hour to ask me that? Well—"

"I have a telegram from her to you," I said, hurriedly, trying to stem the rising flood.

"You have like—cinnamon!" he roared. "It was my wife that woke me up and told me there was an idiot ringing our door bell."

I stood staring blankly at the closed door—which had closed, by the way, with quite some momentum. Anyway, that eliminated 1024 Chestnut Street. I wended my way doggedly toward Brown Street.

I will not dwell on the harrowing details of the interview at 413 Brown. I will draw, as the novelists say, a merciful veil. There are many ladies among the readers of this magazine, and—oh, well—. Suffice it to say that the H. Peck who resided at 413 Brown Street was NOT the H. Peck I was looking for. And he told me so. Explicitly!

Persistence will win, and eventually I stood at No. 4 Center Avenue. I rang the bell. The response was gratefully and astoundingly rapid. Before the sound of the bell had died away, a window on the second floor flew up, and a scared little man in a night-cap peered down at me. "What is it?" he asked in trembling, apprehensive tones. "Are you H. Peck?" I mumbled through cold stiffened lips. "Yes, sir," came the quavered affirmative. "Is your wife in Ashheap, Ohio?" "Yes, sir," more quavery and much more apprehensively.

"Thank God," I said fervently. The little man fairly beamed. "Yes, sir," he said.

"Telegram from her for you—wireless message, you know," I said. The scared look returned to the face of the victim above. "Be right down," he said, hurriedly.

Two minutes later, after a preliminary rattle of drawn bolts and dropt chains, he opened the door and scrutinized me closely. Standing still to be scrutinized at the existing temperature brought my already badly strained temper to the rupture point. I was about to say something, calculated to bring action of some sort quick, when the little guy spoke. "So you are a telegraph man," he said.

"Telegraph man is right," I retorted. "Substituting for Dr. Cook. If you're a human being ask me to come in."

"Certainly! Certainly! Come in, it's cold." Which was the first sane remark I'd heard for hours.

Once in the scrupulously clean parlor into which he led the way, I handed over the white elephant of a message with a sigh of relief, and took a slant at my host as he read.

He was a little man, with a head as bald as a billiard ball and scrubby side-boards. Hen-pecked was written on his countenance as plainly as tho it had actually been branded on his hide. You know, the type cartoonists use as models. As he read the message from his better three-quarters, he paled visibly, and for a long time he continued to study it with perturbed countenance while I sat patiently twirling my accursed derby.

Finally he lowered the message and looked at me. "Excuse me for a moment," he said, hurriedly. "I must attend to something at once." And without waiting for a reply he left the room.

I waited patiently. In about ten minutes Mr. Peck reappeared. He was apparently very much perturbed. He looked at me thoughtfully for a moment before he spoke. "How much does this wireless service cost per word? I would like to send a reply to my wife." I assured him that there was no cost attached, that by these little services we amateurs justified our existence. "And how many words am I limited to?" he inquired.

"Go as far as you like," I invited, carelessly. Then with more caution, "That is, within reason, of course. I don't know that I'd care to transmit the story of your life, or anything like that. Be as brief as possible and be explicit. Use your judgment." I pulled a couple of forms from my pocket and handed them to him. "Go get 'em."

Mr. Peck trotted obediently from the room. I reckon obedience was a habit with him. Judging from appearances, marriage had been more of an enlistment to the poor little animal than anything else, and he looked and acted as if he had had lots of what the U. S. Army officers call good, healthy discipline.

After some little wait Peck came into the room and handed me a folded blank. He was profuse in his thanks. Assuring him that a world of thanks and a mint of money could never repay me for what I'd been thru that night, I made my get away.

The return trip was practically without incident. It was so cold that the policemen could not sleep, and I encountered two or three of these restless knights who seemed to possess inherently suspicious dispositions. I satisfied these minions of the law that I was what I didn't seem, i. e., a peaceful and law-abiding citizen, and eventually arrived at my home. As I mounted the steps I reflected on my innocence of a few hours before. Adam must have had much the same thoughts after he had gotten outside of the historic apple.

I entered my apparatus room, threw off my coat, hat and muffler and lit the gas. Then I sat down to wait until my fingers had thawed out sufficiently to give a fairly decent imitation of continental.

It was four-thirty. I had quite a few doubts as to whether Jim was still holding the fort at the other end. So as soon as I possibly could I sat down to the table with H. Peck's reply unopened in my hand. Throwing down the antenna switch, I jerked forth three rather unsteady 3 F. U. L.'s. Then I listened. Right back at me came faithful old Jim's —. —. When it came to sticking to his post, Jim had out-Binnsed Binns!

Down went my antenna switch, and I tore off the preliminary call while opening H.'s little composition with my left hand. Then I paused, as the full force of the tragedy bore home on me. Henry had obeyed instructions like a soldier. He had been both brief and explicit. He had evolved a regular one of those "we have met the enemy and he is ours" things. It follows:

To Mrs. Maria Peck,
Ashheap, Ohio.

I had already lit the fire. Billy was in the oven. I am burying him in the garden.

Henry Peck.

My spark buzzed and jumped as I sent this brief account of the tragedy winging along on the first leg at twenty per. For tragedy it was doubtless fated to be for Henry Peck when the common carriers succeeded in filling their contract with Mrs. Peck and dropt her on the station platform at Skunkton. And I strongly doubt if Billy enjoyed the performance any too well.

In conclusion I've got just this to say. If that feline Billy had, during his career on this vale of tears, strayed from the paths of righteousness, I'll bet a 5 K. W. transforming tool against a piece of unimproved real estate two inches by four that he tobogganed into the Sweet Bye and Bye without the least fear of what was to come. At a Methodist camp meeting I once heard a select quartet sing, "Oh what a foretaste of glory divine." Foretaste!! Billy got a mouthful!

The February "E.E."

The February issue of the ELECTRICAL EXPERIMENTER *will contain over one hundred articles treating on Electrical, Mechanical and Radio matters of supreme interest to our readers, both young and old. The Wireless Department will contain several timely and important articles, and all those interested in this subject should not miss them. There will also be a number of highly interesting scientific articles, as well as the usual complement of "How-to-Make-It" and Constructional articles. And while we are on the subject, readers, do not forget to read the "re-mailing notice" on the front cover, whereby you can help to provide good reading for our brave soldiers at the small cost of 1 cent.*

"How Jimmy Saved the Troop Train"—a real live electrical tale, mixed with patriotism, that will hold you spell-bound by John T. Dwyer.

Baron Münchhausen's New Scientific Adventures, by Hugo Gernsback.

New Substitute for the Selenium Cell—A remarkable Light-Sensitive Electrical Device.

How One Patriotic American Concern Is Teaching the Blind to Make Electrical Apparatus.

"New Radio Wrinkles," by H. Winfield Secor.

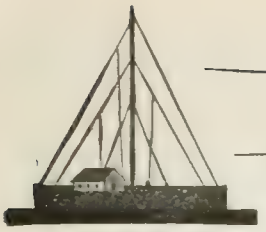
"Experimental Mechanics," Lesson II—describing the "Lathe," by Samuel Cohen.

"High Frequency Phenomena and Experiments," by Frederick Von Lichtenow.

"The Home Treatment of Tuberculosis by High Frequency Currents," by Dr. Frederick Finch Strong.

"The How and Why of Radio Apparatus"—describing Tuning Coils, Loose Couplers, Variometers, Etc., Part VI.

"A Wonderful New Electro-Musical Orchestra," by H. Hartman, C.E.



RADIO DEPARTMENT

Notice to All Radio Readers

As most of our radio readers are undoubtedly aware, the U. S. Government has decided that all Amateur Wireless Stations, whether licensed or unlicensed, or equipt for receiving or transmitting, shall be closed.

This is a very important consideration, especially to those who are readers of THE ELECTRICAL EXPERIMENTER, *for the reason that we desire to continue to publish valuable articles on the wireless art from time to time, and which may treat on both transmitting and receiving apparatus. In the first place, there are a great many students among our readers who will demand and expect a continuation of the usual class of Radio subjects, which we have publisht in the past four years, and secondly, there will be hundreds and even thousands of new radio pupils in the various naval and civilian schools thruout the country, who will be benefited by up-to-date wireless articles treating on both the transmitting as well as receiving equipment. Remember that you must not connect up radio apparatus to any form of antenna.—The Editors.*

"Electrician—Radio U. S. N."

By WILLARD CONNELY, Chief Yeoman, U. S. N. R. F.

IT is easy to understand why electricity is one of the two or three most popular courses of training chosen by youths who enlist in the Navy. The intense modernism in electricity, yet the persistent mystery of it, its new discoveries which seem unlimited, and the unusual chances it offers for frequent promotion—all these forces are so many magnets to the bluejacket who feels within him the steel of ambition.

Since America surged into the War hundreds of college men have enrolled in the ranks of the naval apprentices. So have hundreds of students who quit high school to become sailors. Still, with the personnel of the Navy numbered in hundreds of thousands it is not surprising that a majority of the enlisted men have not completed high school education. Uncle Sam, however, treats them all impartially. Unlike a college, he is not so particular whether or not an electrical aspirant knows Ohm's law at the time he signs up. Soundness of body is the prime requirement.

If a man has learned something of physics at school, often he is fascinated by his experiments in static electricity. If a man has left school to work in an electrical shop and learn the business, often he is kept at primary work, such as armature winding, for months and months before he is allowed to get a broader grasp of the craft. Both these types of men would like to know more about electricity, to study it, to learn something new every day, to get ahead faster, so to rely upon it for a life competence. But they lack the money. Right there is where the Navy comes forth with the needed boost—feeds the apprentices, furnishes all clothes free, teaches thoroly the trade, and good pay for every man starts from the day of enlistment. With this splendid liberal opening which invites young men to serve their country with honor as well as immeasurably to better themselves as expert craftsmen, every amateur electrical enthusiast in the United States should know just what can be had for the enlisting. Then will he meditate.

Too many American youths, indeed thousands of them wedded to electricity, begin at the bottom and—stay there. A dozen insurmountable obstacles may prevent their getting ahead. Unlikely surroundings may stifle initiative. Irregular habits may impair efficiency. But Uncle Sam sees that his bluejackets go forward. He produces—make no mistake about this—he produces electricians.

Three Interesting Views of the Radio and Electrical Students at the Unsaltiest Naval School in the Country—Dunwoody Naval Training School, Minneapolis, Minn. The Future "Blue-jackets" Are Given a Very Thoro Education in the Theory and Practice of Electricity and Mechanics. Top Photo Shows Class in Welding and Brazing.

Development of the mind through disciplinary training will follow. Uncle Sam takes a chance on that, and he seldom loses out.

One of the purposes of this article is to make plain the circumstance that a sailor is not always detailed to the coast or to

(*Continued on page* 633)

THE "SMALLEST AUDION"

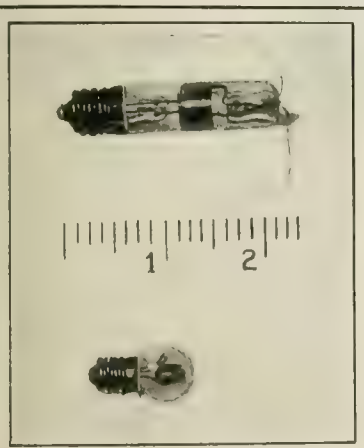
The very rapid strides in the making of electronic receiving devices has rendered possible the production of some very small ones. When the Audion was first made, its size was very large as compared with the present type, but as developments in the art changed this, it was found that the smaller types of the same instrument would perform the same functions as that of the large size.

We show herewith two types of electronic devices which have been made especially for certain experimental work for Mr. Samuel Cohen, a Brooklyn, N. Y., radio experimenter. The Fleming valve is seen at bottom of the photograph, and it consists of the standard miniature 3½ volt filament lamp and the evacuated chamber is $^{5}/_{16}$ of an inch in diameter. The cold electrode is made from tungsten, and is made in semi-circular form in order to receive the maximum electronic discharge from the hot cathode or filament. The connection from this cold plate is obtained by the means of a copper wire which protrudes from the glass chamber, and is seen to the left of the tube in the photograph. With this tube, favorable results have been obtained from nearby signals; the standard Fleming valve circuit was employed.

The de Forest Audion tube is illustrated at the top of the illustration, and it contains all of the elements which are in the standard tube, namely—*filament, grid* and *wing*. The vacuum chamber of the device in which the various elements are enclosed, measures 1½ inches by ½ inch in diameter over all. The *seal-off* is made at the end of the bulb as indicated.

The filament consists of a specially made spiral tungsten filament and this is enclosed in the grid, which consists of another spiral made from copper, the same being kept in position by means of a platinum wire which leads from the lower end of the tube. The wing of this device is composed of a very closely meshed tungsten cylinder.

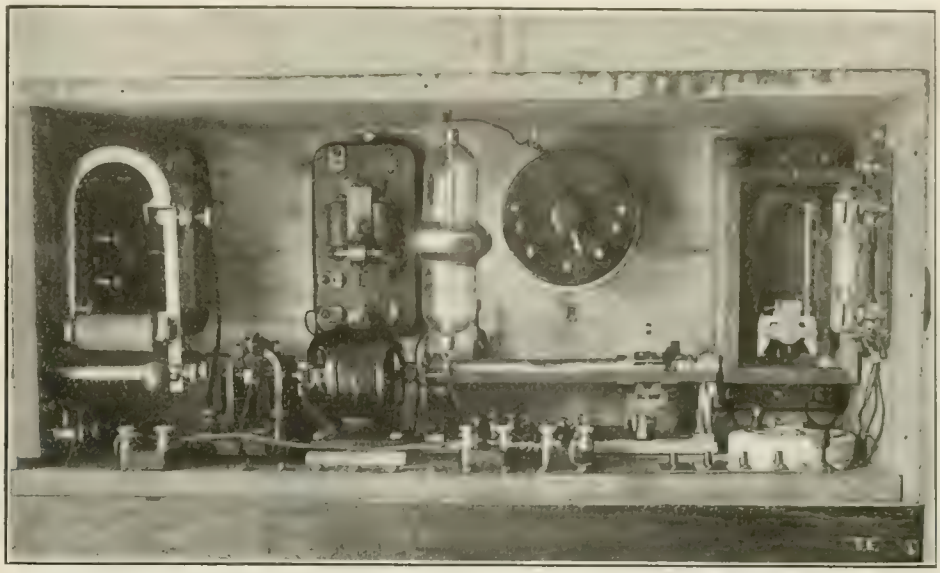
Quite remarkable results have been obtained from this instrument in conjunction with a portable radio receiving outfit. Long distance reception has been obtained with this tube, it having been possible to produce undamped oscillations for the reception of distant stations employing the undamped wave generator. The tube has also been utilized with great success in the making of a "fountain pen" radio receiver, and very interesting results have been obtained therefrom.



Radio Men Are So Accustomed to Seeing Large Sized "Audions," That These Tiny Specimens Might Appear to Be Mere Watch-fobs. But Such Is Not the Case. The Smaller One, at the Bottom of the Photo, Has Done Very Creditable Work Indeed, Even Tho It Is No Larger Than a Flashlight Bulb. The Larger Bulb Contains "Filament, Grid and Wing."

RADIO CONTROLLED MINES

A California genius, Mr. Hyder, has perfected a new radio controlled mine which can be detonated at will by sending out a prearranged radio signal or series of signals. The photograph herewith shows the selective mine construction invented by Mr. Hyder, which cannot possibly be interfered with by any sending device other than the controlling machine, so the inventor claims. This has been tried and tested thoroly under various conditions, and with a number of different radio plants and sending stations, using various wave lengths. It is further claimed that the device has been put to almost every known test condition by the inventor, and so far no person has been able to operate the apparatus except the inventor, nor has any one been able to interfere with the action of the device. Such a device should prove of great value.—*Photo from G. W. Geiger.*



Radio Receiving Apparatus, Including Selective Relays, Wave Filters, etc., Used in Californian's New Radio Controlled Mine. It Is Claimed to Be Non-Interferable, Enemy Waves Having No Effect at All Upon It.

MEASUREMENTS OF RADIO ANTENNÆ ON SHIPBOARD.

In the October, 1917 issue of THE ELECTRICAL EXPERIMENTER, on page 391, Mr. F. A. Hart gives a table of constants for radio antenna. This table is of practically no value unless the spacing of the parallel wires in the antenna is given, says Mr. F. H. Kroger, Chief Engineer, National Electric Signaling Co.. With this additional data the table would, indeed, be of considerable value.

Mr. Hart, in reply, says: I do not agree with Mr. Kroger that the data previously given are valueless without the spacing values, as practically everyone engaged in radio work is familiar with the average spacing between wires. However, with this additional data the table should now be very complete. (Every radio reader should procure a copy of the table previously publisht in THE ELECTRICAL EXPERIMENTER, as it contains data obtained from actual tests.)

Spacing between Wires.

No. 7-Wire	Horizontal Ft.	in.	No. 7-Wire	Horizontal Ft.	in.
1	12	0	23	2	3
2	10	0	24	2	3
3	12	6	25	2	3
4	10	0	26	2	3
5	12	0	27	2	3
6	10	0	28	2	3
7	13	0	29	2	3
4-wire			30	2	3
8	3	4	31	2	3
9	3	4	32	2	3
10	3	4	33		
11	3	4	34	2	0
12	3	4	35	2	3
13	3	4	36	2	3
14	3	0	37	2	3
15	3	4	38	2	3
16	3	4	39	2	3
17	3	4			
18	3	4	*7-Wire*		
19	3	0			
20	3	0	40	1	4
21	3	6			
22	3	4			

In 33 spacing forward is 2 ft. 3 in., 80 ft. *in* to centre spacing between three wires (set each side) 12 in., spacing between two inside wires at centre 19 ft. Aft end 85 ft. from centre spacing graduates to 2 ft. 3 in.

Vertical lengths are identical with horizontal at junction of wires graduating to a point approximately 2 ft. at bottom.

MOUNTING TINFOIL ON GLASS CONDENSER PLATES.

A good shellac for fastening the foil to the glass in transmitting condensers may be made by dissolving as much powdered rosin as possible in one ounce of turpentine and thinning the mixture by the addition of one-half ounce of alcohol. Only a very small amount of rosin will be needed.

About three drops of shellac should be put in the center of the surface of the glass and rubbed around well. Place the foil on the glass and roll it fast with a photographic print roller. The foil must be placed on at once, as the mixture dries quickly. When this varnish is used the plates may either be stacked or placed in an open rack.

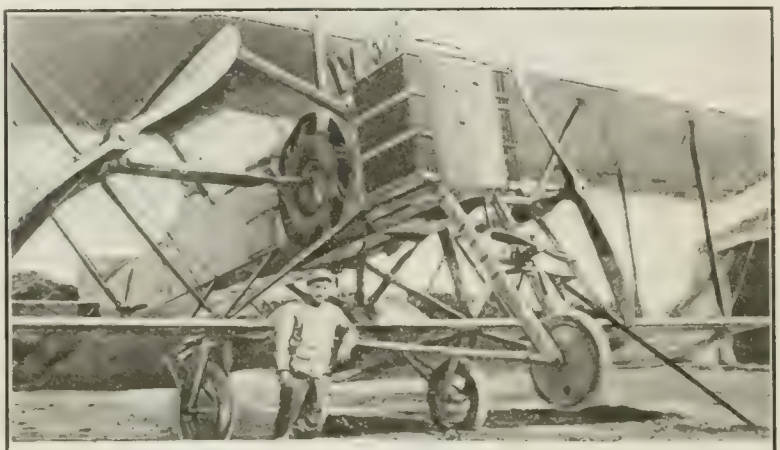
RADIO WRITERS — ATTENTION ! ! !

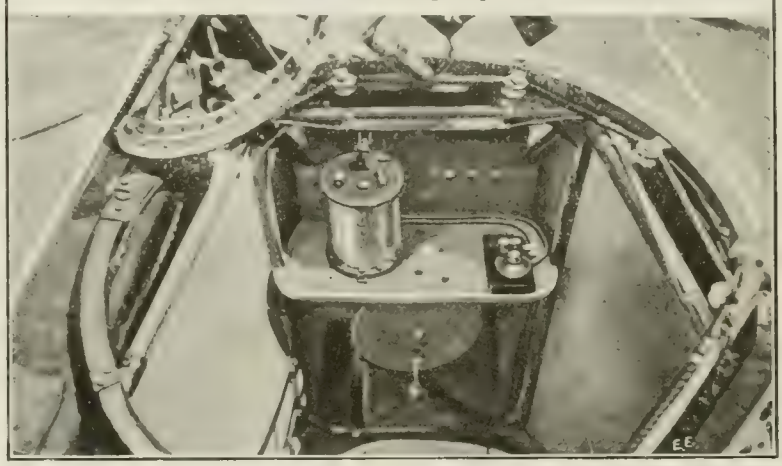
Can you write radio articles dealing with the practical problems of wireless operating? We can use some good papers on such subjects as "the tuning of radio transmitters"; "the use of the wave meter, including its application to measuring the frequency, wave length and decrement"; "operation of commercial transmitting and receiving sets"; "the operation of army trunk sets"; "improved ways of receiving undamped wave signals," also new ideas and short-cuts for learning the codes. We pay well for all articles accepted. Help yourself, your magazine and your country.

French Aeroplane Radio Great Aid to Artillery

ALTHO wireless experiments in connection with aeroplanes were made in 1910, it was not until the beginning of the war that it was put into actual use. All aeroplanes used for the directing of artillery are now equipt with wireless outfits which are powerful enough to transmit a distance of ninety miles if necessary. They can both transmit and receive, the sounds being perceptible in spite of the humming of the motor.

The electrical energy for the transmitter is supplied by a small dynamo which receives its power from a screw placed in front of the machine and actuated by the motion of the air. The aeroplanes keep in touch with their batteries at all times. It is the observer in the aeroplane who controls the gun fire. He sights the objects, gives the signal and reports where the shell has fallen. The top photo shows a French aeroplane fitted with wireless. The small propeller on the right drives the dynamo. The bottom photo shows the wheel or drum upon which the antenna is coiled; also the wireless telegraph set mounted inside the aeroplane cab.





This Photograph Shows Clearly How a French Aeroplane Is Equipt with Radio. The Transmitter Is Supplied with Current From a Small Dynamo Driven By the Small Air Propeller Marked By the Arrow In Top Photo. Lower Photo Shows Transmitting Key and Instruments.

Photo Central News Photo Service

HIGH-POTENTIAL BATTERIES FOR AUDIONS

By Frank Horton, SC.D.

The difficulties attending the use of a high-potential battery capable of supplying a current of a few milliamperes are familiar to all who have experimented with the discharge of electricity thru gases. The type of battery very often employed for this purpose consists of a number of small secondary cells with lead plates. The chief trouble is the "rotting" of the lead of the positive plate at the point where it passes thru the cover of the cell, says Dr. Frank Horton in the *Philosophical Magazine*. The rotting consists in the formation of a white powder which analysis shows to consist mainly of lead sulfate; in a few months, or even weeks, the rod may thus be separated into two pieces. The rapidity of this action depends on the quality of the lead used.

This type of small storage-cell was originally provided with an indiarubber cover, but the contact of the rubber and the lead was found to be the cause of rotting which occurs. The lead rods of the electrodes were therefore covered with short glass tubes to prevent this contact; this device generally lengthens considerably the life of the cell. More recently wooden tops well soaked with paraffin-wax have been substituted for the rubber and glass tubes; but these appear to be quite as bad as the old indiarubber ones. About 20 per cent. of the positives of a new battery of 320 such cells recently rotted thru in the course of three months. The remaining positives, and the new ones replacing those spoilt were therefore covered with glass tubes where they pass thru the wooden covers; but tho as usual, this increased the length of service of the plates, after a few months broken positives were continually being found and the battery was never reliable to any degree.

The rotting of the positive plate is due to electric conduction across the lid of the cell when wet with sulfuric acid. In the case of the wood and indiarubber covers which fit tightly round the lead, the action goes on more rapidly than when the rods from both plates pass loosely thru glass tubes. The rotting may be prevented altogether by doing away with the cover, but some other device is needed to keep the plates in position and prevent the splashing of the acid when the cell is being charged. It would be convenient to have the glass cells made with ridges to keep the plates vertical, but such cells cannot be obtained at the present time. In a long row of cells in series the connecting wires can be made to keep the plates in position, but a safer device is to cut a strip of thin celluloid of width equal to the distance apart of the plates and to bend this into a ∩ and place it between the plates of the cell. The top of the celluloid separator should be below the level of the acid in the cell and a small hole should be made in the top of it to allow the gases to escape when the cell is being charged. The splashing of the acid can be prevented in the usual way by covering the surface with a thin layer of oil. A battery of secondary cells arranged in this way has been working satisfactorily for several months.

The advantage of a battery which does not require periodical charging is obvious. Several types of primary cell have been used and are usually satisfactory for electrometer work and for experiments where potential only (or only a very minute current) is required. They are often troublesome to fit up, but require no further attention if treated carefully. For currents of the order of 0.01 ampere dry cells may be used, and the writer has found these very convenient for this purpose. These cells have the advantage of being small, thus enabling a large number to be packed into a small space, and their E.M.F. falls but slowly when current of only a few milliamperes are taken from the battery.

One such battery is for supplying potentials up to about 200 volts. The cells are contained in a wooden box 61 cm. long, 18.5 cm. wide and 11.5 cm. high. This has a hard rubber plate on the top which insulates the plug-keys by means of which the cells are arranged in series. The cells used give about 4 volts. It is advisable not to have too many cells connected in series when the battery is not in use, and the box therefore contains three sets of 10 small batteries (each set giving about 40 volts), and five sets of five small batteries (each set giving about 20 volts). The sets are insulated by micanite, and they can all be connected in series by means of the plug-keys. The required potential is tapt off by inserting special plugs into holes in the insulated brass pieces connected to the cells.

In the other arrangement of cells which has been found useful the box contains 25 separate dry cells and gives a total E.M.F. of about 35 volts. The cells are connected in series inside the box and by turning a handle in the centre, the difference of potential between the two terminals can be increased by aproximately equal steps from 0 to 35 volts. A convenient feature of the battery-box is the ease with which the cells can be removed and replaced by new ones. The cells are cylindrical in shape, the outside being of zinc which is the negative pole of the cell. A small brass cap connected to the positive pole protrudes from the centre of the top of the cell. The cells are each about 5 cm. high and 1.4 cm. in diameter. They are arranged in a circle between two sheets of hard rubber, one of which forms the top of the box and the other is inside the box and is supported from the top by four hard rubber rods. Each cell is held in position by two copper springs.

Inside the box a radial arm makes a rubbing contact with the brass clips pressing on the central projecting positive poles, and the position of the arm is indicated by the pointer which moves over the dial on the top of the box. This arm is connected to a left-hand terminal; the other terminal is connected to the zinc of the first cell in the series. It has been found convenient in practise to have one position of the pointer in which there is no connection between the terminals ("off"). This forms a simple method of breaking the battery circuit. It is also convenient for some purposes to have a position in which the terminals are connected, but with no difference of potential between them ("0"). The next position

(*Continued on page* 652)

A Short-Cut to Code-Learning

By THOMAS REED

The main difficulty in learning the telegraph or radio code, lies in the fact that the code-signs (composed of dots and dashes) cannot be exprest in spoken words. They are symbols to the eye only, and the mind cannot talk to itself about them, lacking names to call them.

One can, of course, translate them into sounds by using the words "dot" and "dash"; but the repetition of these words, in varying order for the different letters, soon destroys their distinctiveness. To illustrate, imagine the difficulty of recalling the names of six men called respectively "James Henry Albert," "Albert Henry James," Henry Albert James," "James Albert Henry," "Albert James Henry," and "Henry James Albert."

The idea is already in use, I believe, of representing the dots and dashes by alphabetical letters, using capitals for the dashes and small letters for the dots, thus: F = ffFf; G = GGg, etc. This helps recognition by the eye, but still does nothing toward converting the signals into spoken words which one can repeat to himself and memorize.

Furthermore, the sounds made by the actual telegraph instruments themselves bear no resemblance to the appearance of the dots and dashes, the spoken words "dot" and "dash," or the sound of the alphabetical letter. Leaving out the "sounder" of landlines, and confining ourselves to "radio" signals, we find that they are heard in the form of *long* and *short buzzes;* and the mind is required by a dead-lift effort to associate these buzzes with the dot-and-dash symbols and the corresponding alphabetic letters.

But, as heard in the radio receiver, each signal has a distinctive cadence of its own, which is instantly recognizable as a whole and not as a series of dots and dashes; just as a word is recognized as such and not as a series of syllables. In fact, the signal sounds almost like a little word or phrase, pronounced in a lisping language. Take the letter "Y," for example; the receiver says, "Siss-a-siss-siss"; and all of us, after gaining familiarity with it, cease to call it "dash-dot-dash-dash," but express it to ourselves as "tah-de-dah-dah," using the phonetic equivalent imitating the cadence we actually hear, if not the sound itself.

Reasoning from this unconscious habit, I have thought it would assist in learning the code if we could select for each letter-signal a certain word (disregarding its sense) resembling the sound of the signal in the number of its syllables and in its accent. Such words could be more easily memorized than could arbitrary arrangements of marks; and each word would carry in itself not only the audible sound of the signal in the receiving instrument, but an index of dots and dashes composing it.

I have selected a list of phonetic catch-words which can be used in this way. The initial letter of each one corresponds to the alphabetic letter which it represents. The accented syllables (usually with long vowels) correspond to the dashes, while the unaccented syllables (usually with short vowels) correspond to the dots. To assist still further, the dash-syllables are printed in capitals and the dot-syllables in small letters, the syllables being separated by hyphens for greater clearness.

The student, having memorized the list of words, is now provided with a reference-index in his head. He is not obliged to remember the arbitrary fact that "L," for instance, is "Dot-dash-dot-dot." The word "la-Bor-ri-ous" occurs to him because it begins with "L," the letter wanted; and, on analyzing it, the long, accented syllable indicates a dash, and the shorter ones dots, correctly placed. But even without analyzing it, the sound of the word itself gives him the clue to the signal.

The pronunciation of the catchword also gives the correct *spacing* between the dots and dashes, a thing sometimes quite hard for a beginner to comprehend.

Further, in receiving, the broken buzzes of the signal "L" form a sound resembling the word "Laborious," and by associating the two he will learn more quickly to recognize the signal as a whole, instead of first having to resolve it into its component dots and dashes.

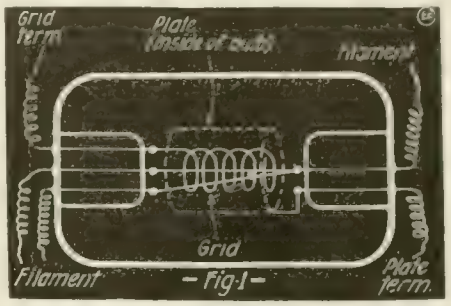
Following is the list of phonetic catchwords. They are the best I have been able to find in the limited time I have been able to give to the matter, and for some of the more difficult letters I have had to use short phrases instead of single words. However, among the great mass of words in our language, a set should be found accurately fitting the requirements. Only familiar words should be used, and such as are not variable in pronunciation. The ELECTRICAL EXPERIMENTER might open a competition in such lists, with the idea of combining the best words into a perfect set, which could thereafter be used as a standard. [*We shall be pleased to hear from any of our readers on this subject.*—EDITOR.]

Alphabetic Letter	Tel. Code Sign	Graphic Sign	Phonetic Catchword
A	.—	aA	a-WAY
B	—...	Bbbb	BLUE-ber-ry-ing
C	—.—.	CcCc	CO-ca-CO-la
D	—..	Ddd	DRA-per-y
E	.	e	etch
F	..—.	ffFf	fil-i-PI-no
G	——.	GGg	GAL-VAN-ic
H	....	hhhh	hel-ter-skel-ter
I	..	ii	in-ner
J	.———	jJJJ	ja-PAN-NOW-OWNS
K	—.—	KkK	KAL-so-MINE
L	.—..	lLll	la-BO-ri-ous
M	——	MM	MA-LAY
N	—.	Nn	NA-vy
O	———	OOO	O-HI-O
P	.——.	pPPp	par-TAKE-FREE-ly
Q	——.—	QQqQ	QUITE-HARD-to-SAY
R	.—.	rRr	re-LA-ted
S	...	sss	sau-sa-ges
T	—	T	TAME
U	..—	uuU	un-a-WARE
V	...—	vvvV	ve-ry-re-MOTE
W	.——	wWW	with-OUT-WAR
X	—..—	XxxX	X-cel-lent-MEN
Y	—.——	YyYY	YEO-man-NO-MORE
Z	——..	ZZzz	ZO-OL-o-gy

INSTITUTE OF RADIO ENGINEERS' OCTOBER MEETING.

The regular monthly meeting of the Institute of Radio Engineers held at the Engineering Societies Building on October 3, 1917, was attended by a very large number of Radio men.

The paper to be presented was on the subject of "Radio Telegraphy in competition with Wire Telegraphy Overland," but owing to a censorship at the last moment, this paper had to be set aside for some future time.



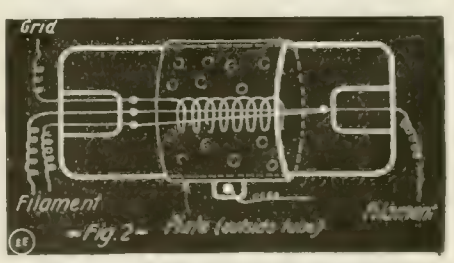
Type of Vacuum Tube Described in Mr. Moorehead's Paper Before the Institute of Radio Engineers at New York. Filament Grid and Wing Are All Inclosed in Evacuated Vessel.

Two other interesting papers were read instead. The first described a new type of Edison storage battery for the "B" current of Audions by Miller Reese Hutchinson, and the second the "Manufacture of the Moorehead Tube" by Prof. Moorehead.

Mr. Hutchinson's paper covered principally the development of a unit of storage batteries which would supersede the use of "flashlight batteries" for the high voltage circuit, which would be compact, reliable and capable of withstanding all forms of abuse and still have a long life on each charge.

Mr. Moorehead's paper dealt with the development of his vacuum tube, the various manufacturing processes, experiments, etc. In Figure 1 is shown the structure of the tube, the grid consisting of a copper wire coil and the plate of platinum, while the filament is of tungsten. Various claims were made for the success of this tube. Another type is shown in Figure 2, which was brought out to get around Dr. de Forest's patents evidently: the construction being the same, except that a strip of perforated brass gauze is placed around the outside of the tube for the plate terminal, instead of inside the tube.

Both papers were read by members of the Institute, the authors not being present, and therefore queries were not answered



Second Type of Vacuum Tube Described in Mr. Moorehead's Paper on the Manufacture of This Class of Radio Detectors. Wing Terminal Outside of Bulb.

Very little discussion took place, altho some members took occasion to state that the Moorehead tube had not been found, in their experience, to be as sensitive as the Audion in actual tests.

"Ham" Aerials

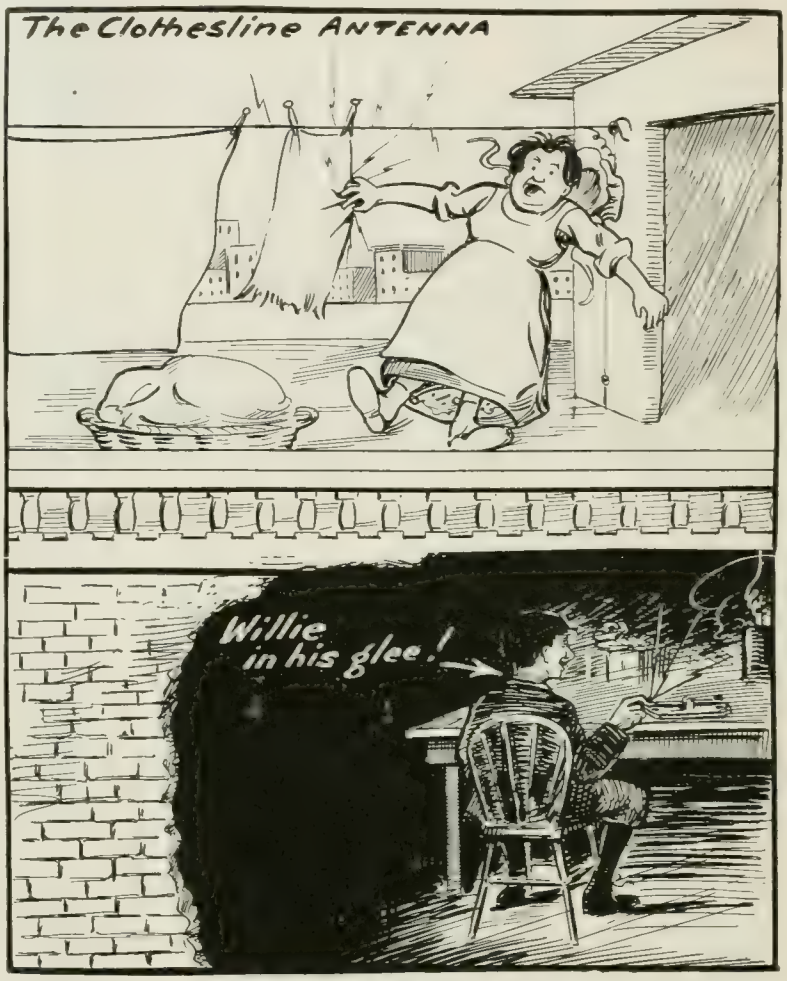
By W. J. HOWELL

AERIALS? Sure we know what they are, you mean those wires strung up in the air on top of the house, and that in some way or other send and receive electro-magnetic waves, or at least did before the order to remove them which makes the top of the house look respectable now, but say, between you and me and the lamp-post, an aerial is the cause of more funny business and trouble that ever was visited on the poor lads that take up wireless. How so? you ask. Well, it happened this way, at least in my experience, and believe me, it has run from anything to everything.

To start this line of chatter right, I should say that I started in the "Ham" class somewhere along the middle of the year 1909, and of course put up an aerial of two aluminum wires forty feet long on two poles ten feet high, nailed to the chimneys. But it so happened that I had nailed said poles to the type of chimneys that have a nice heavy granite block on the top, three feet by one and one-half feet, and of course, desiring to have the aerial up as high as possible, I had only allowed the pole to over-lap about a foot.

The reason for this long description is apparent when things begin to happen, and things did start with a wallop. It began the Saturday afternoon that Teddy returned from Africa and took the form of a beautiful storm right in off the old Atlantic. Barnum and Bailey's Circus was flooded while it was up at the Polo Grounds and it seemed the animals were raising the dickens because of all the things Teddy did to their friends at home. The wind blew and the New York City College had a bill for a new flag pole the very next day. By all the laws of Hamville my poles should have stayed up, but I guess they wanted to do a little celebrating on their own hook, and they certainly did, for one pole goes over, and from the previous description it will be seen that the pole acted just like a big lever, thereby prying the granite block off, letting it drop a mere distance of five feet, gaining speed and weight and ending up by putting a hole in the tin roof, which, of course, let the rain in and our ceiling looked like a sponge.

Lots of fun, that finished off with an order from the owner of the house that Willy should not erect any more aerials on the house top. Things looked gloomy alright till the time when the roof was fixt and the owner discovered that the house needed a chimney of tin for the main smoke outlet. This was put up and stood some ten feet tall with plenty of guy wires, which of course did not worry me in the least, for I took the wires off of the nails and put tape on the nails before putting the wires back in place, and signals came in just about the same. But the joke of the whole thing was that the owner lived on the ground floor and shortly after the smoke stack was put up, said owner looks up the airshaft, sees the wires from the chimney, gets excited and sends the janitor up to cut Willy's aerial that hung in the well—I mean airshaft. He was one of those rare specimens of stupidity and cut the wires as ordered with the result that the house blame near needed a new chimney.



" . . . Speaking of Using Phoney Stunts for Aerials Reminds Me of One Stunt I Tried. This Was to Put Insulators in the Wire Clothes Lines on the Roof and Use Them for Sending and Receiving. All Went Well Till the Maid Got the Surprise of Her Life. Willie Was Calling His Pal—Via Wireless."

This was my clue to ask the owner if he would be so kind as to let me fix the same and of course Amateurs will not need to ask why.

Another stunt I tried was to have a curtain roller mounted on the house about six feet above the fire escape and let it take up the aerial of four wires that I had rigged up, to pull out on the clothes line when it was not being used. This worked, but the aerial was only about twenty feet long and so the signals did not come in very well at that time, altho I suppose that if I had had the "real sets" of today, I should have had "phenom" results. After this idea I tried a wire forced into the space between the porcelain coping on the top of the brick walls of the house and was able to receive a fair amount with it. These experiments all took place during the days of old W. A. and N. Y. which gave us amateurs plenty of juice for testing purposes, if you lived anywhere in the vicinity of said stations.

Later on I was able to put an aerial on the house next door and it was some antenna, believe me. Forty feet long, spreaders four feet and had four wires, these being strung about ten feet above the roof, one end hooked to a sky-light and the other to the top of a dumb-waiter shaft. I was in luck when I could get "Key West" on galena with home-made instruments and seventy-five ohms built into the craziest pair of ear-laps you ever saw. Things went along fine until something happened and the aerial pulled or tript one of the Navy Yard's messages and I had a fanlight to pay for. Oh, it's a great life if your aerial don't come down.

After a while I became acquainted with a chap who lived about four hundred feet away and we put up a wire for telephone and telegraph work. The results were fine and the wire also acted as a great aerial; in fact, we even went so far as to be able to both receive at the same time and talk about the way the fellow was sending by using the telephone, altho situated two blocks apart. Along about that time Sayville began sending press at fifteen words per minute, which was then about the speed limit of *yours truly*, while my friend was right there when it came to copying WHB at about twenty to twenty-five per minute. Now both stations had the dodgasted habit of sending at the same time and generally the stuff was different, so by sticking a variable condenser in the ground wire my friend was able to tune to 600 meters for WHB and I got Sayville on about 1800 meters, and if I remember rightly, at the same time, so nothing was mist. Of course, if either of us varied our tuning arrangement, it threw the other fellow out a little, but this was easily overcome by trial and then leaving the set tuned. One advantage at the time was that the other chap could not tune up to Sayville, so if he wanted to copy the stuff, I used to receive it on my set, still using the 'phone wire and then hold the receiver to the transmitter for him to hear. Talk about duplex working and phoney stuff, we had the time of our lives monkeying with that wire strung along the edges of the roof.

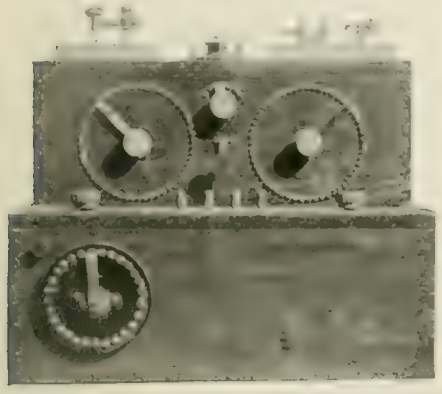
Putting up aerial masts seems to be my middle name and I have gone thru the stages of the game where Willy goes up on the roof every *five minutes* to look at his wires (and the more he has the better), to the point where one lonely wire constitutes the antenna and the only time I've looked at it was when stuff didn't come in.

(Continued on page 651)

A Mechanical Inductance Changer

By FREDERICK J. SCHLINK

WHEN listening for various radio stations we find that it is necessary to continually shift our tuning coil sliders or switches, so that we may hear the different wave length signals. This manipulation is necessary since the law requires that



Front View of Motor-Driven Inductance Tuning Switch as Fitted in Lower Left Corner of Standard Radio Receiving Cabinet.

the transmitting apparatus radiate sharp waves and we find that each station "comes in" at sharply defined points of the tuning coil; the usual "stand-bi" being of little or no use and resort is had to the continual changing of the tuning coil switches or sliders.

This operation soon becomes tiresome and will never give the satisfaction that is to be had by the use of a mechanical inductance changer. The following plan has given far more satisfaction than was really expected of it.

A tuning coil was made separate from the usual receptive apparatus and was tapt off in the usual manner, making 30 points to three (3) turns each, using wire of size No. 22 or larger. The cylinder on which the wire was wound is four inches in diameter and fourteen inches long, and this amount of wire and method of tapping has proved ample for the usual amateur and commercial stations. There is of course no unusual difficulty presented in adding more wire or switch-points or conforming to any other method of tapping.

This tuner, while incorporated in the case of the regular receiving apparatus, is not connected to form a permanent part of the receiving circuit for the reason that it would offer some difficulty to the manual changing of the inductance, in that it does not partake of the advantages to be had by the use of the "dead end" arrangement. This device is used only for the purpose of finding the various stations after which the apparatus is disconnected by the switch A, Fig. 1, and found again on the regular receiving apparatus. This change is very quickly accomplisht and one soon learns just about where a particular point on the auxiliary coil can be found on the regular receiving coil, if calibrated or simple numbered scales are used on the tuners and condensers.

The tuner was connected in the usual manner to the switch points and the hour-hand shaft of an ordinary eight-day clock was projected thru the front of the case, the switch arm having been mounted directly on it by soldering. It is suggested that the current be lead to the switch-arm thru the washer upon which the switch-arm moves; this precaution is for the purpose of obviating any imperfect contacts that might result if the current is brought to the switch-arm thru the clock-work and hence thru the bearings to the arm; it is quite easy to solder the lead to the washer and also to the clock-work.

The clock was dismantled and the unnecessary mechanism was removed, that is to say, the alarm movements, the small spring on the balance wheel and the escapement movements. A small vane or windbreak was constructed of a piece of number 20 or 22 B. & S. wire, bent as shown in Fig. 2. This vane was then covered with silk. The vane is for the purpose of making the clock-work unwind slowly and steadily and if after constructing the apparatus it is found that the switch revolves too fast or too slowly the remedy lies in making the vane larger or smaller.

It will be necessary to bore a small hole in the switch face thru which the winding stem of the clock-work will project; this hole should be a little larger than the winding stem so that the key may be inserted.

It will be noticed that in most clock-work mechanisms that the shaft of the balance wheel projects beyond the brass frame of the work and to this protruding shaft the vane must be soldered. This soldering may be accomplished by forcing a sheet of thin paper over the little shaft projection and then soldering the wire of the vane to the shaft using a drop of acid, a bit of solder and a small soldering iron. The purpose of the sheet of paper is to prevent the solder from joining the frame, vane and shaft together which it will do if this precaution is not taken. It may be possible in some clocks to mount the vane within the works, which method is to be preferred. In some types of clock-work the winding stem is on the opposite side from the dial side and some ingenuity must be displayed so that the clock-work may be wound up.

Some kind of a motor stop must be provided and here again the method of construction will differ with the various types of clocks; a light lever arrangement that will slip between the revolving blades of the vane may be sufficient.

The operation of the apparatus is simplicity itself: Have all inductances of the regular receiving apparatus at zero unless your aerial has a small natural wave length,

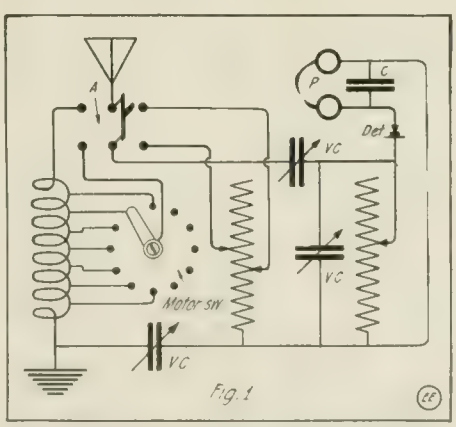
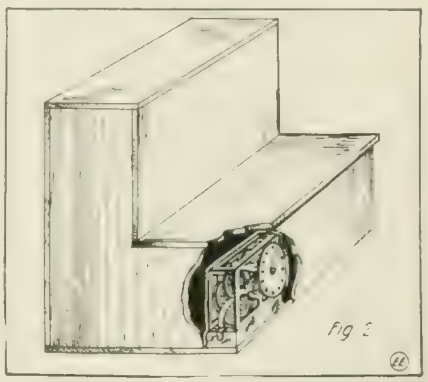


Diagram Showing How the Motor Switch Is Connected for Broad Wave Tuning in Picking Up a Station; Once the Station Is Heard, It Is Tuned in Sharply on Usual Instruments.

in which case it will be necessary to leave in some inductance of the loading coil, the amount of which will have to be determined by experiment. The condenser capacity will also have to be determined experimentally. Start the motor (clock-work) and "listen in" when any station or some desired station is sending, close switch (A), stop motor, and tune in station on regular receiving apparatus.



This View of Mechanical Inductance Changer Shows How Clock-Work (or Other Motor) Is Fitted Inside Cabinet.

ANENT THE HELMHOLTZ RESONATOR AS RADIO AMPLIFIER.

The application of the Helmholtz Resonator to radio work as described on page 266 of the August "E. E." had occupied some little of my time before the declaration of war, and in addition to its use as an amplifier as described, I found that even more important and useful is the effect that it has on interference of any kind.

The resonator transmits and amplifies sound waves of its own frequency, only. Hence any sound waves in the radio receiver differing in frequency from that of the resonator will not pass thru it. For example: say we have a resonator responsive to sound waves having a frequency of 500 cycles; we put this on a radio receiver in which a number of stations, including a 500 cycle set, are coming in, and in which, as well, considerable static is present. Static having a low, scratchy pitch will be excluded from the ear by the resonator, and signals of any station which does not have a spark tone frequency of 500 will also be excluded. The 500 set which you desired to copy will be all that you will hear thru the resonator and his signals will be somewhat louder than in the 'phones, due to its amplifying property.

I have been able to receive a friend's station excellently thru the worst QRM and static by having him vary his rotary until his spark pitch was in tune with, or at the same frequency with the resonator I was using. The only disadvantage is that the combination of 'phone and resonator can not be clasped to the ears as receivers are, but must be set on a table; making it a very uncomfortable position for the listener. Now who will make some practical improvement of this scheme so that the resonator and 'phone may be made in one unit and fastened to the head, receiver-fashion; and so cause it to be of real value to the wireless field?

Contributed by H. O. BIXBY

RADIO EXPERTS WANTED!

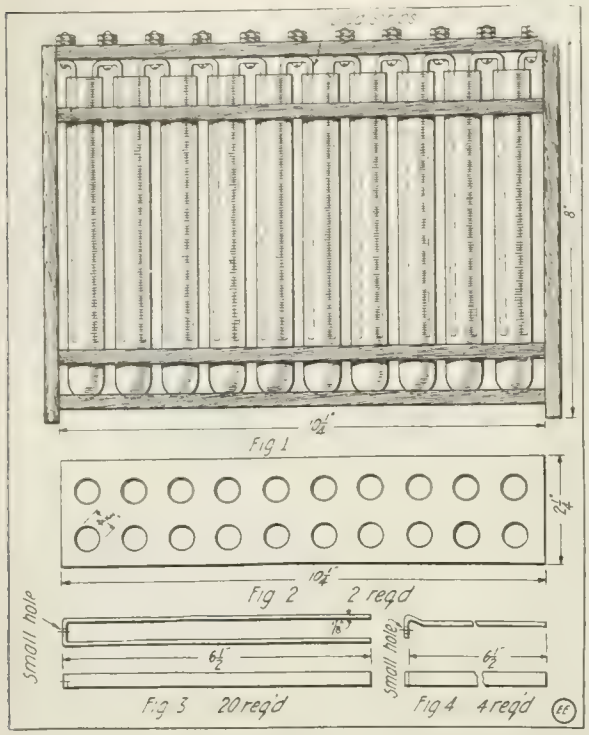
To write up your new ideas and apparatus which have proven efficient and practical. Send us a short, clear write-up with sketches and photographs when possible. We pay good rates for all articles accepted. Address the Editor "Radio Department."

A HIGH POTENTIAL STORAGE BATTERY.

By Thomas Lewis Herren.
(University of Chattanooga.)

The chief drawback of the vacuum valve detector to the average amateur is the cost and upkeep of the high potential battery, which usually consists of 10 or 12 flash-light batteries. The writer here describes a high potential storage battery which has proved to be very efficient when used in connection with a vacuum valve, for testing purposes. The material required for it is as follows:

(20) 3/4 inch × 7 inch test tubes
18 strips of lead shaped as shown in Fig. 3
4 strips of lead shaped as shown in Fig. 4
1 rack or frame as shown in Fig. 1 and 2.



For Those Who Do Not Have Available a Direct Current Source For Operating Audions on, This Small High-Voltage Storage Battery Will Prove of Valuable Service. It Can Be Charged from a Small D. C. Dynamo or from Gravity (Blue-stone) Cells.

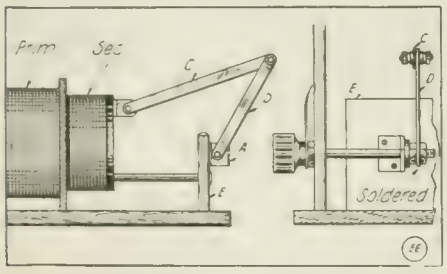
Enough solution of 25% sulfuric acid and 75% water (by bulk) to fill the tubes within ½ inch of the top. In mixing the sulfuric acid and water always pour the acid into the water, stirring vigorously with a glass rod meanwhile. The lead strips are fastened to the top strip of the frame by means of brass machine screws and nuts. Taps are taken from there to a multi-point switch conveniently located. The rack may be put together with small brass screws and glue. After the battery is assembled, it is ready for charging, which may be done by a small dynamo of about two amperes output. With a charging current of two amperes, the charge will be completed in about 15 minutes; with one ampere in about thirty minutes. It can also be charged by means of an electrolytic rectifier. This battery with usual care will give very efficient results and will last a number of years. It is only necessary to charge it about every three or four months, and sometimes less than that.

ROTARY ADJUSTMENT FOR SECONDARY OF COUPLER.

Many amateurs wish to make cabinet receiving sets, but hesitate to do so because there is difficulty in the coupling adjustment of the secondary.

As every amateur knows, the method of bringing the adjusting rod thru the end of the cabinet is not satisfactory, as it bends easily and causes no end of trouble. If they build their couplers as shown they can have rotary adjustment and it is very simple.

But little explanation need be given, as the sketches explain everything. This much may be said, however; make the angle bracket A out of very heavy brass, as this must stand all the strain. A scale may be placed on the outside of the panel and very close adiustment is possible



With This Simple Lever Attachment Any Loose Coupler Secondary May Be Controlled from a Rotary Knob.

Contributed by HOWARD STORCK.

METHOD FOR INCREASING SENSITIVENESS OF SILICON AND GALENA.

I have found that silicon may be rendered considerably more sensitive for use as a radio detector when treated as follows:

Place the piece of silicon in a boiling solution of caustic soda (sodium hydroxid) and boil for about five minutes. The solution should be about 10% strength. Remove from the soda and wash well, in five or six changes of BOILING water. Place in a solution of hydrochloric acid, made by mixing one part of strong acid with one part of water. Boil for about fifteen minutes. If the liquid is strongly colored repeat the operation. Wash the silicon well with hot water several times, then rinse with pure alcohol and dry. The pieces of silicon so treated should be kept in a closed bottle and should not be handled more than is necessary. I have treated silicon that would not work as described with excellent results.

To render galena more sensitive and also to resensitize a piece which is no longer useful, boil a piece of the mineral in a strong solution of ammonium acetate [N H_4 C_2 H_3 O_2] for about fifteen or twenty minutes. Pour off the liquid and boil several times with water, pouring off the water each time, then wash with alcohol and dry. Keep in stoppered bottles. To make ammonium acetate solution, take one ounce strong ammonia water and one ounce of water and add to it acetic acid in such amount, stirring constantly, until the odor of ammonia has gone.

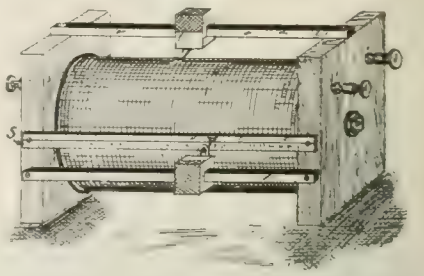
Contributed by ROBERT W. JAEGER.

THE SIMPLEST SPINTHARISCOPE.

Herewith is a description of a simple spinthariscope. It is composed of a "Radiolite" watch and a microscope. Focus the microscope on one of the numbers on the dial and you can see the emanation from the radium in the letters, striking the zinc sulfid. The stronger the microscope the better it works, but it must be in the dark. Contributed by BURLEIGH GARDNER.

SCALES FOR TUNING COILS.

Finding that a scale on a tuning coil is of great advantage in locating stations, I am submitting the idea for the benefit of some other amateurs.



This Precision Slider Indicator and Graduated Scale Will Enhance the Value of Any Tuning Coil Many Times.

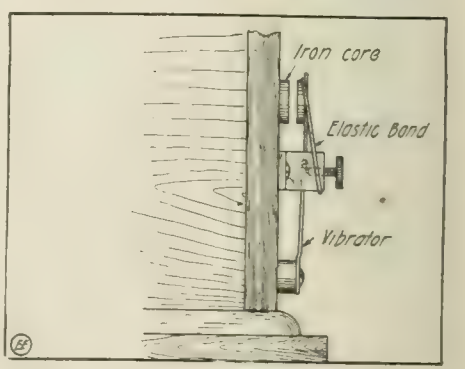
The scale may be made of thin sheet brass covered with white paper and should be about half an inch wide and as long as the tuner. It is fastened at the side of the slider rod and the slider is equipt with a pointer, also made of brass, to move over the scale. The paper scales are very well pasted on tin strips to hold them rigid. The slider indicator is unique, the point itself being drilled and filed to leave an opening as shown—giving a precision form of needle, similar to that used on commercial instruments. When a station is tuned in, and after listening a while, the operator desires to tune in others, the number at which the pointer points is noted, and after listening to others, if the operator wishes to tune in the first one, all that is necessary is to move the pointer back to the number it pointed to before and the station is in tune, without waste of time in relocating it.

Contributed by SCOTT E. VANCE.

MAKING A SPARK COIL MORE EFFICIENT.

A novel way to make your spark coil give a much larger spark than usual is described below and can be done very easily.

Secure an elastic band and wind it around the top of the vibrator and the other end of the band around the thumb screw (the band should be tight). It will be found that the vibrator has been pulled back toward the thumb screw, thereby making a larger and more musical spark because the spring is stiffer.



To Obtain a Higher Pitch from Ordinary Spark Coil Vibrators, Simply Snap a Rubber Band Over End of Vibrator Spring and Bridge.

Contributed by AN EXPERIMENTER.

Useful Hints on Electric Motor and Dynamo Testing

By SAMUEL COHEN

UNDOUTEDLY many of the readers would like to know how small electric motors and dynamos are tested. It is the purpose of this article to show how it is done. With small machines it is not practicable to test the same way as one would a large machine. This article will deal with generators or motors below ¼ H.P. capacity.

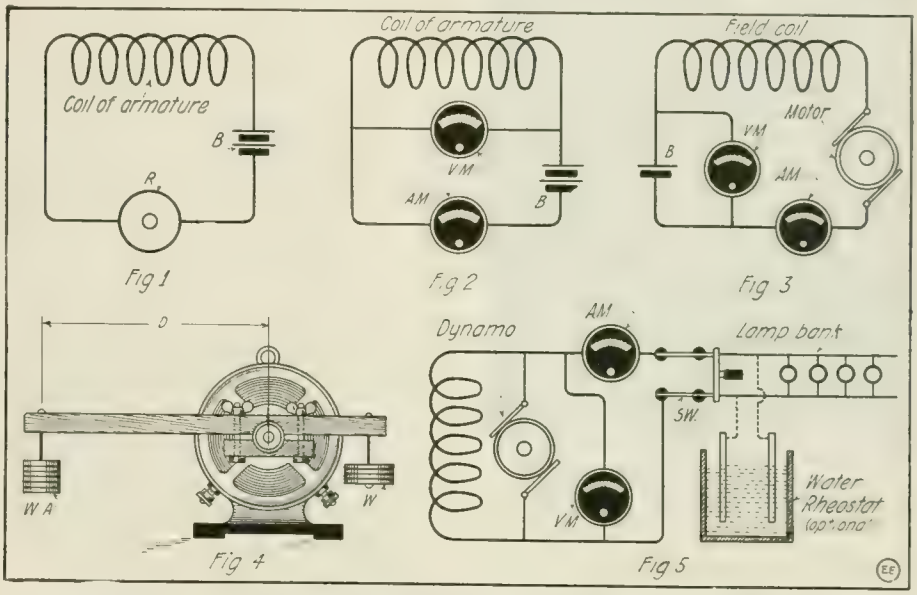
The first procedure is to test the armature and field windings for *continuity*. This is done by means of a galvanometer or telephone receiver. The indicating device is connected in series with the coil and batteries as shown in Fig. 1. If the coil is not broken, the galvanometer needle will deflect to one side, when the circuit is completed. Next, we have the test for *leakage*, that is, whether any part of the winding touches the frame. Join the wire from the galvanometer or receiver to the frame, while the other wire of the battery connects to the coil; if there is no movement of the needle when the circuit is closed, there is no leakage and the insulation of this particular winding is perfect. But if a *very* slight click or movement of the needle is observed, this may be due to the dampness in the insulation, which cannot be helped.

The commutator should now be tested with the battery and indicating instrument, in order to see that each segment is not short-circuited with its neighbor. This is best done by attaching one wire of the battery to one segment and the other wire of the galvanometer to the adjacent one; watch for any movement of the needle. If none occurs, it indicates that the segments are not touching. Each and every one of them should be tested in the same manner. It is advisable to test the resistance of each coil in order to find out that they have the same amount of wire, providing that they are wound with the same gage. If the commutator and the brushes are clean, their resistance will be infinitesimal in comparison with the coils and therefore it may be neglected. The general method is to connect each coil thru its corresponding segment to a Wheatstone bridge, either of the arm or box type. Instructions for the use of this instrument are to be found in any up-to-date electrical book. If a bridge is not at hand the volt and ammeter method can be successfully employed and connections for using them are given in Fig. 2. Connect as shown and take simultaneous readings on both instruments. After the readings are obtained, they should be next substituted in the equation $R = \frac{E}{I}$ (Ohm's law) where R is resistance of winding in ohms, I current in amperes and E voltage drop across winding. Two values of I and E are known and the third R is obtained by solving the equation. Every coil should be tested in a similar manner.

The various parts having been tested, the next step is to test the complete machine. In the first place it should be firmly screwed or bolted down and the bearings well oiled, the belt tightened, the brushes properly placed and making good contact with the commutator and see that all connections are firmly and properly made. The field coils should be tested for their proper polarity with a compass needle. If it is found that they possess the *same polarity*, one of them must be oppositely connected or else remagnetized by passing a powerful current thru them.

In testing motors, a volt and ammeter will be required and also a *prony brake*, a frictional device for testing the horse-power developed by a running machine. The instruments are connected as indicated in Fig. 3. The speed is also taken in these tests and this can be obtained by using a speedometer, which can be obtained at any hardware or machinery supply store. Fig. 4 illustrates a simple prony brake. It consists of two wooden blocks clamped on the motor pulley by means of two small bolts. The small weight "W" on the right is to counter-balance the longer arm, and should be adjusted until the brake is perfectly balanced on the pulley. This is very important. When the perfect balance is obtained the two bolts must be tightened, by turning the hand nuts, until the brake begins to clamp the pulley. When the machine is running, the nuts are tightened, and a weight "W A" is then added. This weight is increased in order to keep the brake balanced. As soon as the brake is balanced during the maximum run of the motor, the brake absorbs the power developed by the motor. A lamp bank, made up of miniature incandescent electric lamps or a water resistance will be needed for the absorption of the current. An ammeter should be connected in series with the lamp bank or water resistance, a voltmeter shunted across the dynamo brushes and a double-pole switch as indicated in Fig. 5. Now run the machine up to speed and then close the switch and regulate the resistance until the meters indicate the maximum output at which the machine is rated. If the machine is of unknown output then regulate the speed and load to the point where the maximum watts output is obtained with only slight heating of the machine. It should be kept running for one-half hour and the speed recorded every five or seven minutes.

If the machine fails to generate, altho connections are properly made, the direction of rotation should be reversed or the position of the brushes altered. If all these



The Present Discussion, With the Aid of the Accompanying Diagrams, Aims to Bring Out the Fundamental Tests to be Made On Motors and Dynamos, Both Large and Small. Every Radio Operator, Electrician and Experimenter Must Be Thoroly Familiar With These Principles, For They Are In Daily Application In Every Branch of the Art.

horse-power is then obtained just by multiplying the R. P. M. of the speedometer reading, by the distance "D" in feet, times the weight in pounds (W A) and then by the factor .000194. The horse-power can also be measured directly by means of the prony brake, by first loading the arm with a weight and clamping the brake on to the pulley firmly, then gradually increasing the speed of the motor and the longer arm placed upon a spring balance or scale. The former method is more practical for smaller machines as the power developed by them is very small.

The efficiency of a motor can be readily obtained by knowing the input in watts; that is, volts times amperes, and the power developed in watts. Then divide the latter by the former and the result obtained is the efficiency of your machine.

The result obtained in the prony brake test is in *foot-pounds per minute*, and to convert it into watts, it is necessary to divide the quantity obtained by 44.24.

In the case of testing a dynamo, some means must be made for absorbing the power generated, the same as the prony arrangements do not help, the only remedy is to remagnetize the field with some separate source of current until they are partially magnetized. Sparking at the commutator should be eliminated as much as possible; there are several causes for this, such as loose connections, dirty brushes, short-circuits, over-loading of the brushes, over-loading the machine and worn-out bearings.

The efficiency of a dynamo can be obtained in the same manner as in the motor. The efficiency equals the electrical output divided by the mechanical input. To illustrate this, let us take a typical example: suppose that a dynamo of 150 watts capacity requires a motor of ½ H.P. to drive it. What is the efficiency of the generator at its maximum load? The solution is as follows:—there are 746 watts in one H.P. therefore, ½ H. P. 373 watts; divide this into 150 watts which result is .42 and in terms of percentage, (*i, e.*, multiplied by 100) 42 per cent is the efficiency of that particular dynamo. The larger the machine the higher is the efficiency. The electrical output is obtained from the volt and ammeter readings.

THE CONSTRUCTOR

Experimental Mechanics

By SAMUEL COHEN

LESSON I.

THE mechanical and electrical amateurs of today are far better off than their ancestorial fellow amateurs who have bitterly strived in building their models without real tools. This of course was a great drawback in respect to rapid developments of certain devices which they were working with. However, the present day experimenter has the greatest mechanical facilities which he can utilize in the making of his various models. It is often found, however, that the experimenter with the greatest facilities on hand is unable to go forward with his ideas because of lack of proper equipment as he is unfamiliar with the tools, and the kind that he is required to purchase. On the other hand, many amateurs who possess a number of tools and other equipment are unable to obtain best results therefrom on account of lack of ability to handle them.

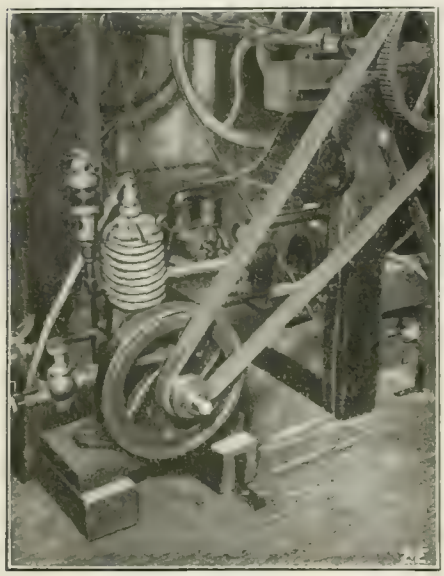


Fig. 2. A Very Satisfactory Work-shop Power Unit, Comprising An Air-cooled Gasoline Engine Rated At ½ H.P. It Is Belted to the Line Shaft. Two Small Dynamos Can Be Seen Just Back of the Engine.

Another great drawback which the amateur had to contend with is with the improper layout of shop and laboratory equipment and which case was noticed in the Amateur Contest page of this journal, and the various inquiries which the Editors have received. For the above reasons the author has endeavored to bring forth this series of lessons in order to indicate to the reader how to rig up a shop and laboratory so he can acquire the best methods of handling the more important tools.

The first and most important thing that the novice should consider is to obtain a fairly large room with plenty of light and sufficient ventilation. A room with the dimensions of 20 feet deep by 10 feet wide is just the size which would prove an ideal room and Fig. 1 shows a general layout of the various parts.

Of course, it is not compulsory to follow exactly the same layout since each one will be controlled by his resources and location. The lighting of the various portions of the shop should be either by electricity or gas; electric light being usually found in most of the homes of amateur mechanics.

It is presupposed that the reader has a fair knowledge of carpentry thus enabling him to construct the various shelves and benches. The most important one is the *shop bench* which is made from 1 inch stock and measures 7 feet long by 2 feet wide. The legs should be made of heavy square timber and 3x3 inches is quite ample. Nails should not be used in joining the various sections; use ample large size wood screws. Shelves should be placed in convenient locations. The tool cabinet may be of the drawer type which can be utilized for holding various measuring tools and different sizes of drills, taps and dies, etc.

In selecting the various tools necessary to carry on the shop work it is advisable for the novice to write several of the best toolmaking concerns for catalogs, in order to obtain the best idea as to prices and quality of the goods.

Let us consider that the reader has acquired a good judgment as to the company from which he would purchase his tools. The first tool he should obtain is a good vise, which should be of the parallel jaw type and its size may vary from 2 to 5 inches. It will be found that the 2 inch size is excellent for light work while the 5 inch variety is suitable for heavy work. The former type should be fitted with auxiliary lead jaws and the latter with copper ones. It is advisable that the vises be so mounted that the operator can work with the smaller one while sitting down.

The next important tool is the lathe and in this case great care must be exercised since several factors control the selection. First, you may decide to start with a plain lathe of good quality, so constructed as to admit of conversion to screw-cutting at a later date, or the experimenter may get one of the several low priced screw-cutting lathes on the market.

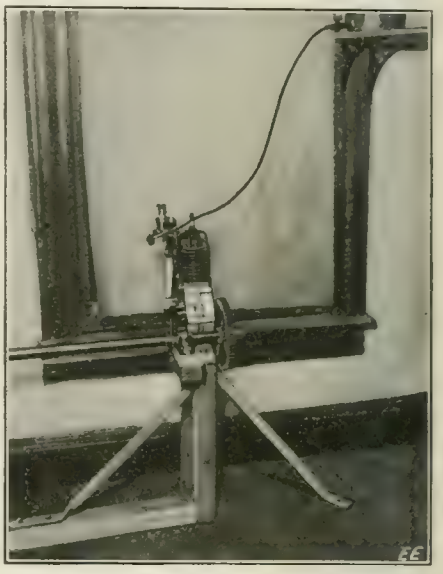


Fig. 3. This Form of Drive for An Experimental Work-shop Makes Use of a 3½ H.P. Motorcycle Engine. It Is Geared to the Line Shaft. A Rawhide Or Comprest Paper Pinion On the Engine Will Reduce Any Noise.

In the first place and before purchasing the lathe, some form of motive power should be considered so that undue trouble may be eliminated when the necessary equipment arrives. The author at first utilized a foot-operated lathe, which he has found to be entirely satisfactory for beginners and for handling light work. However, he has found that for doing actually good work on a lathe some other form of motive power is required and a small gasoline engine of ½ H.P. was utilized with great success in driving a 9-inch swing screw-cutting lathe. In Fig. 2, this engine is shown coupled to a countershaft by a one-inch belt. The exhaust pipe is led out thru the window and the whole engine is substantially secured to the floor as noted.

In opening our new department, "Experimental Mechanics," we do so with the full conviction that it will be welcomed enthusiastically by the majority of our readers.

Mechanics and electricity are so closely interwoven today, that neither can possibly do without the other. Too many experimenters and amateurs are dependent these days upon machine shops, cabinet makers, tinsmiths, etc., when wishing to build certain new apparatus or instruments. Every amateur experimenter should be able to build his entire "rinktum" right at home, without outside help.

And by studying the lessons of our new course, he will be placed in a position whereby he will accomplish this end—and much more. Thousands of very lucrative positions are open to the man who knows how to handle tools and how to build models from the base to the last gear. And such experience can only be gained by doing the work with one's own hands. The time spent and the money invested in the necessary equipment will most assuredly pay handsome dividends, and rapidly at that.

It runs very quietly in this manner and the consumption of fuel is very small. A 3½ H.P. motorcycle gasoline engine was also utilized at times which is illustrated in Fig. 3.

This was an old discarded engine which was overhauled and repaired and then utilized for power purposes. The countershaft was geared to the engine as shown. It is advisable that the prime mover be in the form of either a gasoline engine or electric motor; the latter is more advisable since it is very steady and noiseless and further, its power can easily be utilized for driving the various machines by individual drive, which will be treated on in a later article.

Many readers, of course, will not want to secure an expensive lathe and for them the author advises a treadle operated, small speed lathe, and the amateur today can obtain a fairly accurate one for about $25.00. The beginner will find this type of lathe very satisfactory, and for the first several months he should become familiar in handling ordinary *hand* turning tools for both wood and metal. He will then be in a better position to manage his more complicated lathe, and he will never regret the time spent. Later as he becomes a master in handling the ordinary lathe with hand tools, he should then proceed to purchase a more expensive one, and it is an excellent plan to keep the cheaper one for wood turning and metal spinning.

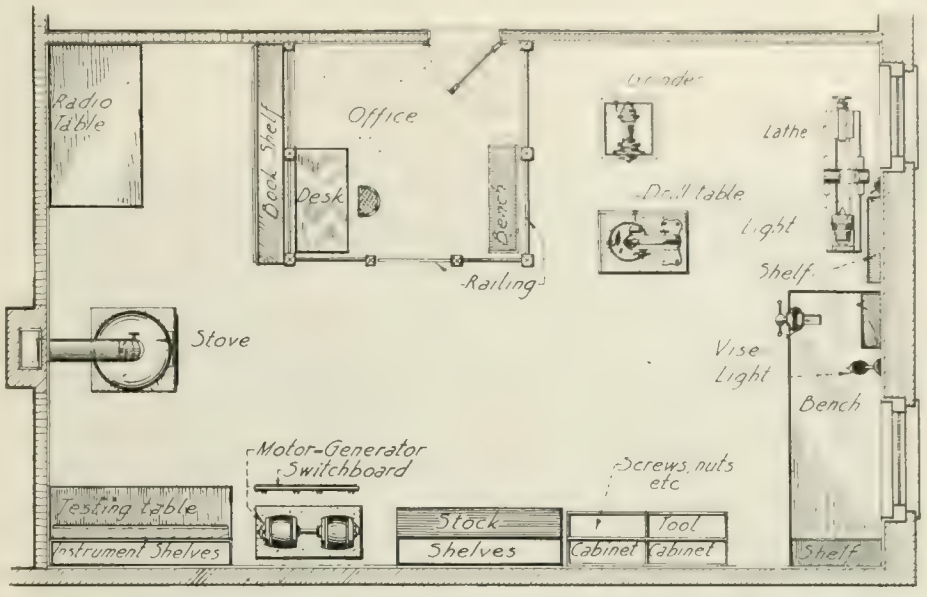


Fig. 1. A Very Efficient Arrangement of the Various Machine Tools, Benches, Shelves, Etc., Is Shown In the Plan Herewith of the Author's Work-shop.

When procuring a lathe the following accessory tools will be found necessary: A face-plate, driver-plate, two centers, and a hand tool rest, together with a dozen or so ¼ inch bolts and nuts for clamping purposes. One of the most valuable tools for the lathe will be found to be a chuck, which is not usually furnished with the lathe, and this device is very essential, especially when metal turning and drilling is to be done. A self-centering three or four-jaw chuck can be purchased for a nominal sum and it will repay the purchaser in a short time.

The operation and the handling of the lathe will be fully treated in the second installment of this series. Having obtained the lathe the following list of tools will be found very useful and the writer suggests that the beginner should not purchase the complete list at one time, but gradually until the set is completed.

The first thing is the hammer and two are sufficient, one about 4 oz., with a cross pene, and one 2 lbs., with the ball pene. The smaller should be purchased first since much work can be done with it. A copper or brass as well as a raw-hide hammer is useful for finishing up work. This of course is optional to the amateur.

A hack-saw is most essential and it should be one of the best make; a good one can be secured for about $1.50 and it should be of the adjustable type in order to handle blades ranging from 6 to 12 inches. The tension is adjusted by the handle, which should not come off at the critical moment. The blades should usually have fine teeth (23 per inch), but for certain work such as in cutting cast or wrought iron the "star" coarse pitch blade is the only one to use. Fine pitch blades with many teeth, are good for brass and copper.

The next important tool is the *file* and on its quality and suitability to the job depends the pleasure of one's work. They should, therefore, be very carefully chosen. The following will be found satisfactory for the start:

(1) For heavy work—One 12 inch hand second-cut; one 12-inch half-round, second-cut.

These will be found invaluable in taking off a lot of metal, as a good sweep can be gotten without fear of bruising one's knuckles.

(2) Medium work—One 8 inch hand, second-cut; one 8 inch hand smooth; one 8 inch half round, second cut; one 8 inch half round smooth; one 8 inch three square, second-cut; one 8 inch round, second-cut and one 8 inch square, second-cut.

(3) Very light work—One or two sets of six 4 inch files of various shapes (flat, half round, round, square and knife) will be found most satisfactory.

A metal brush for cleaning the files will be required and it should be seen that the wire bristles are substantially inlaid so that they are prevented from falling out when brisk cleaning is done.

Chisels—These are readily made in the shop as one can select one in whatever shape or size he desires. The general type of chisels used are the half-round, diamond, cross cut and flat.

For center marking holes after having been laid out *center punches* are used. Two are generally sufficient, 4 inch long, one large one, about 3/16 inch in diameter at the end, and one small one about 3/32 inch diameter.

In regards to *drills* it is advisable to invest in a complete set, ranging from numbers 1 to 60, including a drill stand. It seldom happens that the amateur employs drills larger than a ½ inch and for this larger group the following will be found handy:—¼, 5/16, ⅜, 7/16 and ½ inch. If the novice is unable to purchase the complete set, he can at first simply buy the drills which will suit his purpose most advantageously.

The problem of procuring *stock* and *dies* for the amateur work-shop is important and for this reason it is advisable to procure the following:—2-56; 4-36; 6-32; 8-32; 10-32; 10-24; 12-24; 14-20; ¼-20. All these should be of the same diameter, so that a standard holder will suit. The ⅝ inch type was found to be very convenient. For each *die* the corresponding *tap* should be obtained. In stock and die sets, taper and plug taps are usually included. An adjustable tap wrench should be procured.

Pliers and *Nips* are included among the hand tools and for the former the parallel jaw type is recommended. Toggle jointed cutting nippers are advisable. Gas pliers will be found at times very useful.

Scales and Gages—Among the most important tools in the shop this class should be of the finest grade as the accuracy of the finished work will depend a great deal upon the condition of the layout, which naturally is reflected to a certain degree upon the measuring instruments. A twelve-inch steel scale with the following division will be useful:—⅛, 1/16, 1/32, 1/64 inches. There are several good makes and these can be procured at a nominal price. Inside and outside spring calipers of the 10-inch variety are very handy; a tool-maker's spring dividers and combination square with a "V" centering block is very useful and the amateur should not be without it. A protractor attached to the combination square is very desirable if it is required to layout parts at various angular positions. A combination drill-thread and screw gage or a drill and wire gage (a good one is the "Time Saver"), will be found invaluable. As the novice becomes more experienced with handling measuring tools he can then invest in a micrometer.

The various other hand tools which should be among the other shop equipment are the following:—ratchet, screw driver, wood chisels and planes, hand brace, hand drill, augers, awls, broaches, reamers, glass cutters, wood and iron clams, hand vises, center gage of 60 degrees, countersinks for wood and metal, level, and metal shears.

Grinders and *Polishers*—These should consist of two heads, one for grinding work which should have a spindle fitted for two grindstones, one a corundum wheel, while the other side has a carborundum wheel. It will be found that these types of wheel will be most suited for the work which the amateur will meet with. The other, or polishing head, should be of a lighter construction and the spindle ends should be tapered in order to hold polishing wheels. In some of these polishing heads an extra arbor is made on the same shaft, so that a grinding wheel may be attached to the same head. For the one who does not care to employ two heads, the latter is therefore advisable.

The driving power for these heads can either be a motor or foot-power. If the former is used, a ⅛ H.P. electric motor will be sufficient to drive it. However, if the latter form of power is utilized an old sewing machine foot treadle will be found very useful and cheap to procure.

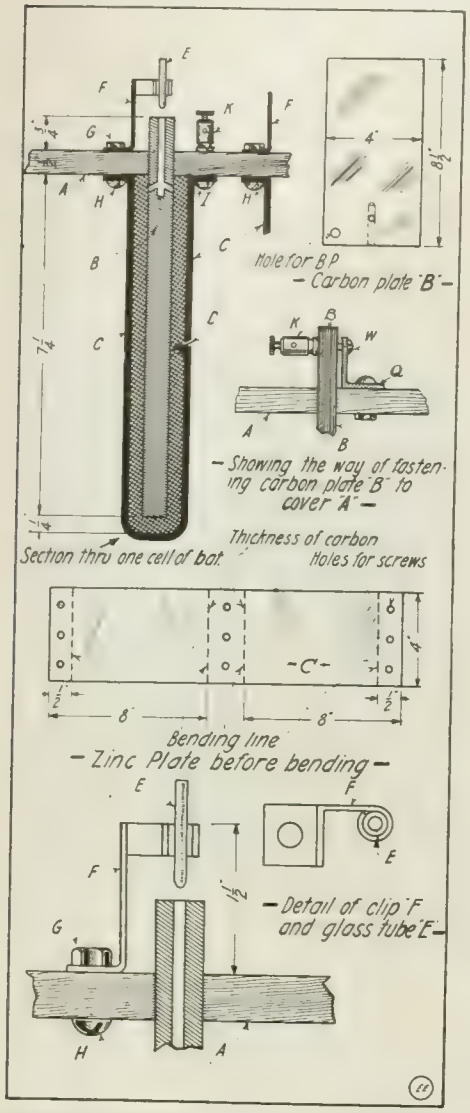
Drill Press—Altho this is not very essential to the beginner, (as most of the

(*Continued on page* 653)

A New Type of Chromic Acid Battery

By C. A. OLDROYD

THE great advantage of all chromic acid batteries is their high E. M. F., namely 2 volts. The voltage drops, however, very quickly if the battery is in use for more than about 10 minutes. Various designs of chromic acid


Hole for B P
– Carbon plate 'B' –
– Showing the way of fastening carbon plate 'B' to cover 'A' –
Section thru one cell of bat
Thickness of carbon
Holes for screws
– 'C' –
Bending line
– Zinc Plate before bending –
– Detail of clip 'F' and glass tube 'E' –

Electrical Students Are Always Partial to the "Chromic Acid" Battery, Chiefly Because Its Potential Is High—viz., 2 Volts. The Author Here Describes How to Build a Very Ingenious and Improved Form of This Useful Battery.

batteries have been brought out, at different times, to overcome the inconstancy and the author will describe in detail the construction of a modified chromic acid battery that will supply a constant current as long as the exciting liquid lasts.

This battery can be built very easily and cheaply and is "just the thing" for spark coils, small motors, electro-magnets, etc. The battery described here consists of five cells; thus giving a total voltage of 10 volts when connected in series. A battery with any number of cells can however easily be built from the directions given.

Each cell consists of a carbon plate B, which is fixt to a wooden cover A. A strip of zinc plate C, bent as shown, encloses the carbon plate B and between B and C is a thin layer of "glass wool" D; that is spun glass, which is used for pocket accumulators and many other purposes. The zinc plate C is fastened to A by means of screws H and I. The latter carries a binding post K, while H is fitted with a nut G.

A small hole is drilled on the center-line of the carbon plate B and two holes are drilled from the sides of the plate to meet the hole first mentioned. The chromic acid is fed into the vertical hole and passes thru the two holes out of the carbon plate B into the glass wool layer D. After passing to the bottom of D the chromic acid leaves the cell thru some holes in the zinc plate C.

The chromic acid is fed into B thru a small glass tube E, which is connected to a container M by means of rubber tubing. The end of E is drawn to a fine point, so that the exciting liquid enters the hole in B in a very fine stream or only as drops, as the amount required is very small. The tube E is held in position by a small clip F which is fastened to A by the screw H and nut G. After leaving the cell, the chromic acid collects at the bottom of the battery jar, as shown in the general arrangement, and is finally drained away thru a glass tube S into a storage bottle R.

To build this battery procure first the carbon plates B; as all the other dimensions are fixt by the size of B. These plates should be about 4" wide by 8½" long. Drill a hole in the right hand top corner of B to suit the screw W. Then drill a vertical hole about ⅛" dia. on the center-line of the plate 1½" deep and from each side a similar hole to meet the vertical hole. The carbon plate B is now finished and we turn to the zinc plate C. The zinc used should be at least 1/16" thick. A strip of the length required is obtained and bent as shown in the sketch. After bending, and not before, amalgamate the zinc plate C.

We can now assemble one cell. A slot is cut thru the cover A to allow the carbon plate B to pass thru and B is fastened by means of a small clip Q made from brass strip about ¾" wide. A screw W is now past thru Q and B and fitted with a binding post K.

We now fit the zinc plate C to the carbon plate B, so that a clearance of at least ⅛" exists all round between the carbon plate and the zinc plate. This clearance is now filled with glass wool and the easiest way to do this is to take a few strands of glass wool at a time and to push them into place by means of a steel rule or a knife.

Now comes the tube E. Take a short length of glass tubing, such as used for chemical experiments and heat it in the middle in the flame of a Bunsen burner till it becomes quite soft. Then remove it from the flame and taking one end of the tube into each hand, pull the ends apart and you will find that the tube is now tapering to a fine point in the center. Break it there and grind the ends down till the opening is big enough to admit an ordinary pin.

The clip F, for the tube is made from thin brass plate and bent as shown. A hole is drilled thru the foot of F to allow the screw H to pass thru. Now adjust the clip so that the outlet of the tube is directly over the hole in the carbon plate. In this way all the cells required, in our case five, are completed and a battery jar of sufficient size to allow at least 1" clearance all round is procured and the cover A fitted to it. One of the rectangular jars used for storage batteries will do very well.

Near the bottom, a hole has to be drilled thru the wall of the jar and this is done best by a glazier, who will do this for a nominal sum. A glass tube S, fitted with a cock U, is fixt into the jar by means of a rubber stopper T. A small glass tube V is fixt into the cover A, after having been bent as shown. A container M of about ¾ of a gallon capacity and tubulated near the bottom is procured and fitted with a cock N. To this cock a branch-piece, having five branches, is joined by means of a short length of rubber tubing and each branch is connected to the tube E of each cell. The container M is now filled with chromic acid and the cock N opened. The exciting liquid travels now thru the branch piece and tubing to E, thru B into the glass wool D and thru the holes at the bottom of the zinc plate into the jar and from here thru S into a bottle R. Adjust the cock N in such a way that the liquid leaves E in drops. To clean the battery after use, close cocks U and N and connect tube V to the watermain; fill the jar with water, allow to stand for a few minutes and drain the water off and the battery will be quite clean.

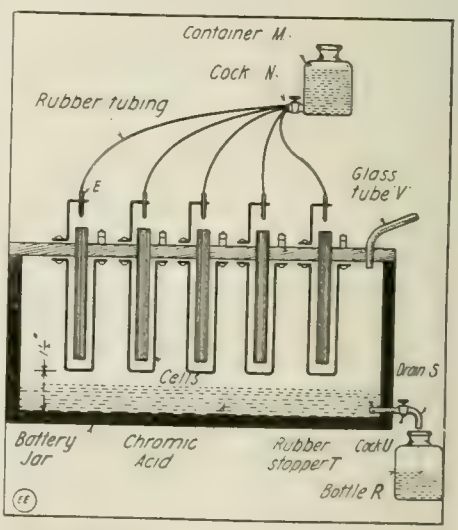
TO KEEP DRY BATTERIES FROM SHORT-CIRCUITING.

When a number of dry batteries are placed closely together in a damp place, the moisture is apt to soak thru the paper covering, making an electrical connection between the zinc casing. To avoid this, remove the cardboard casings and wrap a double layer of friction tape (ordinary bicycle repair tape) around each dry cell near the top and near the bottom. Also stretch two layers of the tape along the shelf about an inch and a half apart. This will insulate the cells from the shelf in case the latter gets wet or damp, while the tape bands will keep the casings from coming into contact with each other even if set close together.

Contributed by PETER J. M. CLUTE.

PRESERVING CORKS FROM ACIDS AND OTHER ALKALIES

I had considerable trouble with the corks which I used in the bottles in my laboratory, from being corroded by acids and other alkalies, so I used the following process to preserve them:—I boiled them for some time in paraffin; they must be kept under the surface of the hot wax and should be heated and allowed to cool, re-



Diagrammatic Arrangement of 5 Cell, 10 Volt, "Chromic Acid" Battery Provided with Means for Circulating the Electrolyte and Cleaning the Container.

peating this several times, so as to get all the air out of the pores. When they are treated as above they cut easily and make very close joints.

Contributed by EDWIN MOTZEL.

The Ultra-Microscope and The Underworld of Infinitesimal Small

By FRANK M. GENTRY

"WHAT is the ultra-microscope and what has it bequeathed to science?" is a question that can be answered by scarcely one person in five thousand. If you must know of this little known but very interesting and vastly important scientific instrument, sharpen your imagination and let us travel into the underworld of infinitesimal small and roam midst molecules and atoms.

When salt is placed in water, it immediately disappears; that is, it dissolves or goes into solution. Just what happens when a substance goes into solution fooled the chemists for many years and, for that matter, has them puzzled yet. Some say it is a case of the mere mixing and intermingling of the molecules, others say it is a case of chemical combination, still others believe it to be an aggregation of the former theories, while many uphold the theory of electrolytic dissociation or ionization. However, it is not our purpose to argue the points of the several hypotheses but rather to study the properties of solution.

If we pass a salt solution thru filter paper we obtain no residue. Again, if we force the liquid thru animal membrane (which has no visible pores) the salt is not yet removed from the water. Salt cannot be removed from solution by any process of filtration. Conversely, if a little starch be dissolved in water, it presents all the characteristics of a true solution until the mixture is forced thru animal membrane, when the starch is recovered from solution as the residue. These mixtures were called by Prof. Graham, of London, *hydrosols* or simply *colloidal* solutions.

Prof. Bredig of Heidelberg prepared metals in the colloidal state by placing two wires of the desired metal in a shallow dish of water and forming an arc, until the solution became saturated, by passing an electric current of forty volts between the electrodes. Colloidal platinum is a deep brownish black color, the gold is a beautiful ruby and the silver is a splendid yellow.

The beautiful ruby glass prepared at Jena and used in church windows and photographic dark-rooms is produced by the introduction of minute quantities of gold into the glass. The state in which the gold existed was long a subject of bitter controversy. Was the color due to gold in solution or was it due to particles of finely divided gold suspended in the glass? Was it a case of true solution or of colloidal suspension? It was this question that led Siedentopf and Zsigmondy to develop the ultra-microscope.

The ultra-microscope consists essentially of an especially constructed microscope of high magnifying power and lenses which serve to bring a powerful beam of light to a sharp focus within the object, perpendicular to the line of vision. There are two theories regarding its operation.

The older explanation, based upon the law of sympathetic vibrations, assumes that since the smallest particle discernible by the ordinary method is about 0.0002 mm., or about 1-127,000 of an inch, which is very near the value of half a wave-length of visible light,—the only way in which a particle of greater minuteness could be made visible is by causing it to emit a light of its own, that is, become self-luminous. Accordingly, a great amount of energy in the form of light is brought to bear by means of powerful lenses upon a comparatively small region of the object under examination. This great concentration of vibrating energy causes the small particles to vibrate in unison with itself and these vibrations, being radiations of visible light, cause the particles to become self-luminous and visible thru a powerful microscope. This beautiful theory, altho romantic, is far fetched and has given way to a later explanation.

The second theory, based upon "Tyndall Phenomenon," is the one generally accepted by science today. It makes use of the principle that dust suspended in the air, while invisible in the open sunlight, is easily seen in a dark room under the illumination of a beam of light. If a beam be past thru a beaker of water it is invisible, but if the same beam be past thru a colloidal solution it is easily traced by a diffused streak. Thus when the submicroscopic particles are illuminated by the coaxial method, employed in ordinary microscopes, they are invisible, since they are encircled by the light waves themselves. But when illuminated by a thin plane of light not exceeding eight wave-lengths, the sub-microscopic particles become visible, on account of diffraction, as bright objects upon a dark field.

But whether this or that theory is correct, is of no concern compared with what has been learned by the use of the ultra-microscope. In former times the limit of direct observation with the best compound microscope was 1-8333 of a millimeter with the aid of a special immersion. Today the limit of visibility of the ultra-microscope is directly proportional to the specific intensity of illumination. With the aid of intense sunlight sub-microscopic particles of 0.0000039 mm., or about 1-6,777,685 of an inch have been detected. The magnification of the present instrument with the most powerful beam obtainable is approximately,

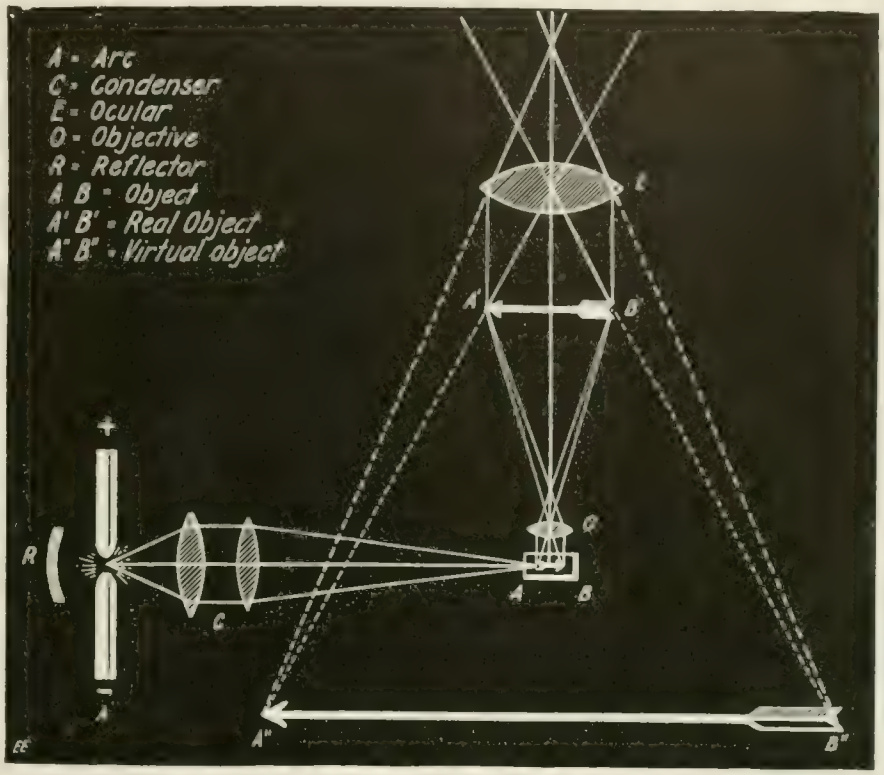
$$\left[\frac{1}{1/600 \div 1/6{,}777{,}685}\right]^2 = 127{,}602{,}778.8996$$

times; where 1/600 is equal to the limit of the unaided eye's resolving power in inches. The hypothetical diameters of the larger molecules are: hydrogen 1-10,000,000 mm., ethylalcohol 5-10,000,000 mm., chloroform 8-10,000,000 mm., and starch 5-1,000,000 mm. Thus we see man on the verge of distinguishing the molecules and atoms, things which scientists dared not dream, and in fact, "the large molecules of albumen and of certain fluorescent substances have actually been seen!"

Gaidukov has shown that the protoplasm, the nucleus of a cell, the starch grains, and the chlorophyll grains consist of a thousand sub-microscopic particles. So far, however, not a single submicroscopic organism has been discovered which has not led to a disagreement between the investigators themselves. The ultra-microscope has found its greatest use in determining the condition of solutions. It has been shown that coloidal solutions contain minute particles of varying size; that there is no distinct difference between true solutions and hydrosols; and that it is possible to pass gradually from one to the other. The particles of finely divided gold have been seen suspended in ruby glass. Since the size of the beam of light could easily be calculated, the particles counted and, knowing the specific gravity of gold and the weight introduced into the glass, it was an easy matter to arrive at their average size. The gold dust in ruby glass averages 1-6,000,000 of an inch in diameter.

The lack of exact reproductive power is the chief defect of the ultra-microscope. It is impossible, however, to eradicate this fault at the present, since the particles are made visible by the interference rings caused by diffraction.

(*Continued on page* 653)



The Finest of Scientific Researches Are Made Possible Only by the Application of the "Ultra-Microscope." This Remarkable Yet Relatively Simple Device Consists Essentially of an Especially Constructed Microscope of High Magnifying Power and Lenses Which Serve to Bring a Powerful Beam of Light to a Sharp Focus Within the Object Perpendicular to the Line of Vision.

HOW TO MAKE IT

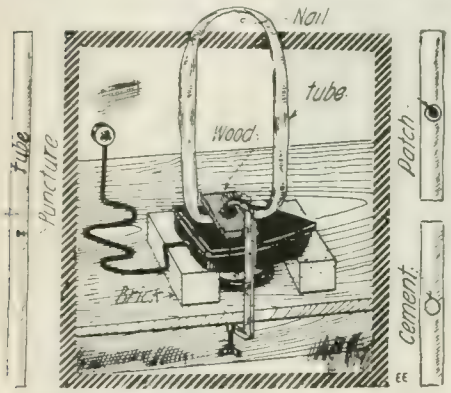
This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

AN ELECTRIC IRON VULCANIZER.

All Bugs and Buglets who own flivvers, etc., may find this wrinkle of some value in saving a small part of the vulcanizer's bill which is always large, by following these instructions closely. First clean the tube around the puncture thoroly with gasoline, now apply some quick cure cement by smearing it on with your finger (don't lick your finger), covering a space about the size of a quarter, next cut out a piece of raw rubber or gum about the size of a dime and cover the hole, but be sure that the cement has dried perfectly before doing so; now all is ready for the cooking.

Hunt up an old electric iron and clean off the smooth surface so there is no rust or other dirt and heat it to about the temperature that is used for ironing and clamp the tube down firmly, then let it cook for five minutes. When you take it off you will have a patch that will not readily come off.



If You Possess or Can Borrow an Electric Sad Iron, It Then Becomes a Simple Matter to Vulcanize Tires in a Few Moments.

And as for the cement and gum you can obtain that at any rubber supply house or vulcanizer.

Contributed by
THEODORE F. LITER.

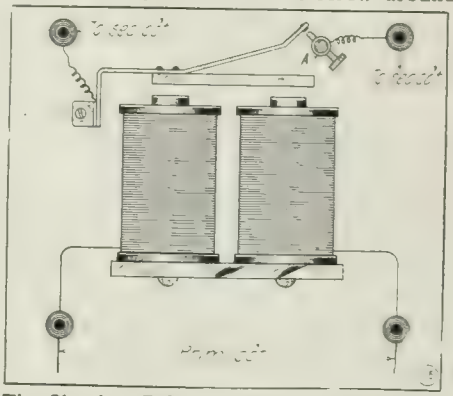
APPLICATION OF RADIO-ACTIVE SALTS TO BATTERIES.

A recent French patent, due to M. H. G. C. Thofehern, is concerned with the use of radio-active material for the purpose of facilitating the chemical action taking place in accumulators. For this purpose radium barium sulfate is suggested. The material is insoluble in the electrolyte, and does not appear to enter into chemical combination with the lead oxid or the metallic lead of the plates. Its presence, however, is assumed to render the chemical action more complete during charge and discharge; otherwise the process is normal. About 0-2 microgrammes of radium per pound of lead oxid is used, the radium compound being merely incorporated in the oxid used on the plate grid.

SECOND PRIZE, $2.00

SIMPLE RELAY MADE FROM BUZZER.

The relay here shown is made from an old bell or buzzer and is fairly sensitive. Twist the adjustable contact screw around



The Simplest Relay Is Made by Twisting the Contact Screw Post on a Bell or Buzzer to the Position Shown, Also Bending the Armature Spring a Trifle.

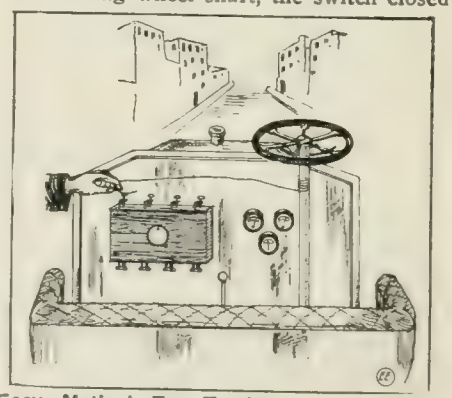
as at (A) and bend the circuit-breaking contact spring as shown.

A wire from (A) is run to a binding post and another from the armature to a binding post.

Contributed by
EDWARD M. WYLAND.

ADJUSTING AUTO COILS.

To adjust the spark coils on an automobile, without leaving the car and turning each cylinder circuit to contact on the commutator, a wire may be grounded on the steering wheel shaft, the switch closed



Easy Method For Testing and Adjusting Auto Ignition Coils.

and the top of each vibrator screw touched with the end of the wire until the proper buzz is heard.

Contributed by JOHN SCHMITZEIS.

TEST PAPERS

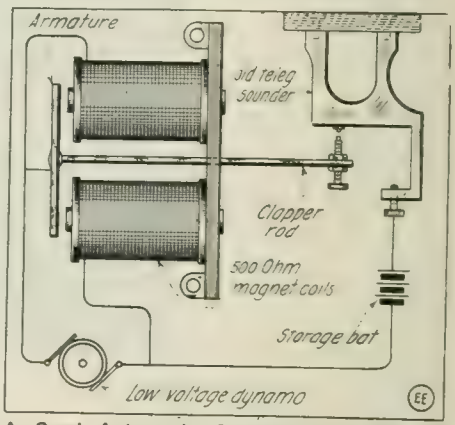
The following are some test papers which I think the experimenter will find useful.

THIRD PRIZE, $1.00

HOME-MADE BATTERY CHARGING CUT-OUT MADE FROM POLARIZED BELLRINGER.

Having some storage batteries I wanted charged and being unable to watch them all the time, I thought of the plan shown in the drawing and it has worked successfully so far. The operation is as follows: When the dynamo generates the proper current, the 500 ohm magnet coils (polarized telephone ringer) are energized, which closes the contact attached to the clapper rod. The storage battery begins charging now and continues to charge until the dynamo stops or something happens, whereby the contact is broken; thus shutting off the battery "juice" from the line.

Contributed by ERNEST JOHNSON.



A Good Automatic Charging Cut-Out For Batteries Is Readily Made From a 500 Ohm Polarized Ringer As Shown.

Use the best filter paper cut in strips, immerse in the solution, and dry in an atmosphere free from ammonia or hydrogen sulfid.

Ferrous sulfat F_eSO_4. Dip in solution and dry; test for hydrocyanic acid cyanides. Gives a blue color.

Iris paper. Make extract of the roots of the Blue Iris (Iris versicolor). Dip paper in solution. Dry.

Neutral solutions give blue; acids red; alkali green.

Lead Acetat. Dip in solution and dry. Sulfides give black.

Pole test paper. Dip in a solution of phenolphthalein and dry. Then in a solution of sodium sulfate.

Negative pole gives *red* spot.

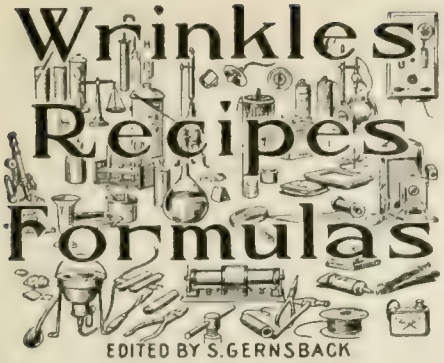
Potassium bichromat. Same as other papers. Lead salts give yellow. Silver salts red.

Silver nitrat. Keep in a dark bottle. Lead gives black; Arsenic yellow; Chromates red.

Dry in air free from H_2S.

Potassium ferrocyanid. Ferric salts give blue. Cupric salts red.

Contributed by F. G. HOPPER.



Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

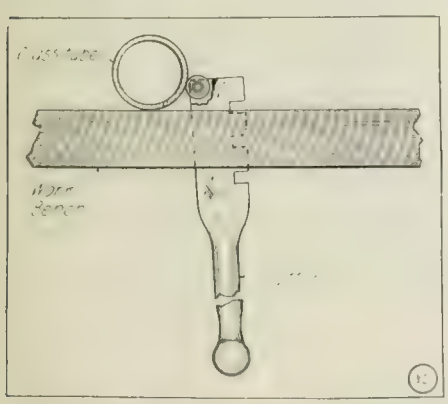
HOW TO MAKE A CHEMICAL GARDEN.

Place a quantity of sand in a wide mouthed bottle or fish aquarium to a depth of about three inches. Slightly imbed a few pieces of copper sulfate, aluminum sulfate, iron sulfate, chrome alum, lead acetate, calcium chlorid, magnesium and manganese sulfates, in the layer of sand (all these chemicals can be purchased at any drug store). Make a solution of water glass (sodium silicate) one part water glass and three parts water, pour this solution carefully over the sand and chemicals. In about a week a dense growth of the silicates of the various bases will be seen, in various colors and fantastic shapes. Now displace the solution of the water glass with clear water, by conveying a small stream of water thru a small rubber tube into the vessel, which will gradually displace the solution of water glass. Care must be taken not to disarrange or break down the growth with the stream of water. Other sulfate such as chromium, nickel, cobalt, etc., may also be used. When successful this produces a very beautiful scene.

Contributed by ALBERT W. PUTLAND.

HOW TO CUT GLASS TUBES.

A good way to cut glass tubes with the ordinary glass cutter is to bore a hole in your work bench and fit a glass cutter in it with the handle down, so that the wheel is about one eighth of an inch above the level of the bench. Lay the tube to be cut against



Cutting Glass Tubes Is Always a Problem to the Amateur. Here's a Simple Method Using an Ordinary Glass Cutter.

the cutting wheel of the glass cutter and turn with the hand as shown in the illustration. This scores the glass so that the tube may be easily broken with the hands.

Contributed by LAVERNE WISE.

SIMPLE TESTS FOR LEAVENING CAPACITY AND PURITY OF BAKING POWDERS.

To ascertain the leavening capacity, place as many glass tumblers in a row as you have baking powders to test. Measure half a teaspoonful of each baking powder into a tumbler by itself, and fill two-thirds full of clear, cold water. Set the tumblers between yourself and the light, observing which throws off the larger amount of tiny gas bubbles. The one that liberates these in the greatest abundance, possesses the highest leavening power, as these tiny globules developing in the dough, cause it to rise and become light.

To test for purity place as many teacups in a row as you have baking powders to test. Deal a teaspoonful of each into its separate cup. Pour a very little boiling water from the teakettle into each and in about two minutes fill with boiling water. After they have stood half an hour to cool, pour each into a separate glass tumbler and set aside to rest. The baking powders that are pure and free from stuffing will be completely dissolved and the water will be as clear as crystal. The cloudiness and precipitate at the bottom of the impure ones will tell the amount of adulteration and of impurity. The tumbler with its solution as clear as crystal contains pure cream of tartar and no adulterants. The tumblers containing turbid solutions and yielding small precipitates contain little cream of tartar but phosfates of calcium and stuffing. The tumblers containing very turbid solutions and yielding heavy precipitates contain no cream of tartar, whatsoever, but plenty of alum and stuffing.

Baking powders containing pure cream of tartar are recognized to be the best by experts while those containing phosfates and alum are regarded to be unwholesome and detrimental to our stomachs.

Contributed by
FRANK BECHTOLD, JR.

BLUE PRINTING

To obtain *white* lines on a *blue* ground:

SOLUTION No. 1.
Ammonia Citrat of Iron.....1 oz.
Water .....4 oz.
SOLUTION No. 2.
Ferricyanid of Potassium.....1 oz.
Water .....4 oz.
COATING SOLUTION:

Directions—Mix equal portions of solution No. 1 and No. 2. Coat the paper with a camels hair brush (like painting) or rub on solution with a tuft of absorbent cotton. Any good bond paper will do, a mat surface writing paper is good. Paper should be dried after coating in a dark room, develop in water.

Contributed by
JOHN BLACKHURST.

TIN PLATING

To tin-plate a small article like a copper penny or a copper statue proceed this way. Put a half teaspoon of tartaric acid in a bright and shiny tin cup. Put the article in the cup and fill the latter about three-fourths full of water and set on stove to boil. Boil till water is nearly all driven off. The article is now tin-plated and a little polishing will make it shine as bright as a new dime. In this experiment the tartaric acid dissolves the tin and plates the object which is in the cup.

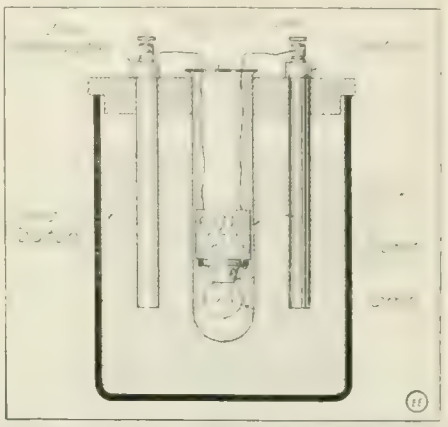
The object to be plated must be clean and free from dirt or it will plate unevenly. To clean the article dip in weak sulfuric acid and dry.

Contributed by
MANSELL SARGENT.

IMPROVED BICHROMAT DARK-ROOM LAMP FOR PHOTOGRAPHERS.

Some time ago you publisht a description of the above type lamp which shows a battery and rheostat connected in the external circuit to light the lamp within the red solution of Bichromat of Potash.

I desire to describe an improvement which is more convenient, less expensive and yet one which will give good service. Place a carbon and zinc within the bottle and connect them to the lamp. Put the following solution in the bottle; dissolve 24 ounces of Bichromat of Potash in 1 gallon of water



Improved Idea for Making a Photographer's Dark Room Lamp Which Incorporates the Battery, Lamp and Red Coloring Solution All in One Jar.

and then slowly add 72 ounces of Sulfuric Acid. If only one-quarter of solution is desired use one-quarter of the above amounts. For the lamp procure one of the lamps now used in operation with a one or two cell dry battery flash-light; they can be bought in the 5 and 10 cent stores for a dime. This battery will give about 2½ volts and can be used for constant service. The zinc will last much longer if first dipt in sulfuric acid solution and rubbed quickly with mercury. To open the lamp circuit remove the zinc rod.

Contributed by THOS. APPLEBY.

BROWN OR SEPIA TONES ON BROMID AND GASLIGHT PAPER

Photographic Printing Paper:—
SOLUTION No. 1.—Bleaching Solution.
Bromid of Ammonia.....1 oz.
Water .....16 oz.
SOLUTION No. 2.
Ferricyanid of Potassium.....1 oz.
Water .....12 oz.
SOLUTION No. 3.—Browning Solution.
Sulfid of Soda..... 1 oz.
Water .....12 oz.
(Do not confuse *Sulfid* with *Sulfite*)

Directions for Brown or Sepia Tones on Bromid or Gaslight Photographic paper:—Take a print from the negative in the usual manner, develop and fix; when thoroly washed, place in developing tray, and develop till image becomes faint in:—
Solution No. 1.....4 oz.
Solution No. 2.....4 oz.
Mix together in container bottle; label bleaching fluid.

Wash once only, (too much washing will spoil the work); the solutions will keep indefinitely. After washing the print, fill the developing tray with water, placing the print in the tray with the water, and add a teaspoonful of (browning solution).

SOLUTION No. 3—Develop till the desired tone is acquired, and wash well in running water.

Solution will not keep.

Contributed by
JOHN BLACKHURST

Experimental Chemistry

By ALBERT W. WILSDON

Twentieth Lesson

VALENCE.

DOUBTLESS many readers of previous installments have wondered how to determine, how to write symbols for certain compounds in order to write an equation. For instance, how are we to know whether to write the symbol of a given compound with 1, 2, 3, or 4 atoms of either of its elements?

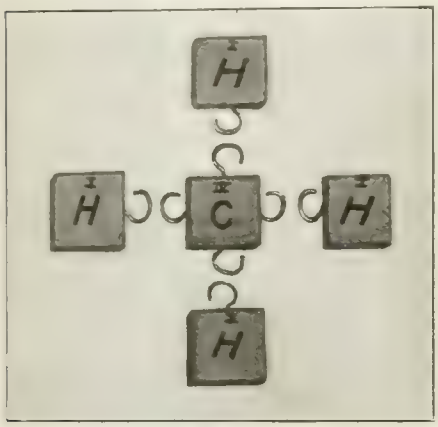


Fig. 1. Illustrating Graphically the Tetravalent Element Carbon (C) in Methane.

For example, shall we write Sodium Chlorid NaCl, Na_2Cl, $NaCl_2$, $NaCl_3$, or $NaCl_4$, etc.? It is evident that one of these is correct; the others must be wrong.

The object of this installent is to ascertain in what way the atoms of the elements combine. In the last paper we took up the study of certain laws of chemistry with respect to the balancing of equations, and the ration with which elements combine.

SYMBOLS OF ELEMENTS AND COMPOUNDS.

When expressing the composition of various chemical substances which are made up of various elements, as a matter of simplicity, an abbreviated form of chemical language is employed.

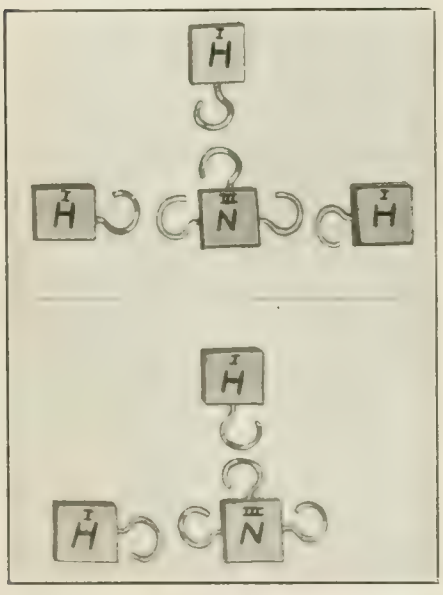


Fig. 4. The Upper Line Illustrates Graphically a Trivalent Or Triad Element—Nitrogen (N) In the Ammonia Radical (NH_3); Lower Line Shows Why Ammonia Could Not Be Written NH_2.

An atom of copper is the smallest particle of copper that is found in any compound. The symbol for an atom of copper is Cu; that of an atom of Oxygen, O; of Sulfur, S, etc., etc. For the symbols of the other elements, together with their atomic weights reference to the table given in the last lesson should be made. Every element possesses a symbol which stands for its atom. If more than one atom of an element is indicated, a co-efficient or sub-exponent is used as 2Cl or Cl_2, which means two atoms of Chlorin.

A symbol is usually the initial letter or letters of the Latin name of the element, which does not in every case correspond to the English name. In some cases several elements possess the same initial letter. It is then the custom to assign the single letter to the most important, abundant or earliest discovered member of the group and to the others another letter contained in the name of the element. Thus, ten names of elements begin with C. This symbol was selected for Carbon as the most important then Ca for Calcium; Cd for Cadmium; Ce for Cerium; Cl for Chlorin; Co for Cobalt, etc.

A few names in which the Latin names differ from the English, are: Fe from Ferrum (Iron); Sb from Stibium (Antimony); Cu from Cuprum (Copper); Pb from Plumbum (Lead); Hg from Hydrargyrum (Mercury); Ag from Argentum (Silver); Na from Natrium (Sodium); K from Kalium (Potassium); Sn from Stannum (Tin); Au from Aurum (Gold).

Symbols possess a *quantitative significance.* Each one represents one atom of the element in question, this being the smallest quantity of an element which is present in the molecule of its compounds. Thus Na does not represent any indefinite quantity of Sodium, nor does Cl represent any amount of Chlorin, but each represent a definite mass, one part by weight. Thus we see that the symbol not only is an abbreviation of the name of the substance, but also signifies a definite amount or quantity of the Substance. Na means one atom of Sodium, also 23 parts by weight of Sodium.

The formula of a molecule is formed by grouping together the symbols of the atoms composing it. The molecule of Hydrochloric acid is found to consist of one atom of hydrogen and one atom of chlorin, expression of which formula is:—

H + Cl	=	HCl
Symbols of elements		Formula of compound

This formula (HCl) means:

1. One molecule of hydrochloric acid.
2. One molecule of hydrochloric acid containing one atom of hydrogen and one atom of chlorin.
3. One molecule of hydrochloric acid composed of 1 part by weight of hydrogen, and 35.46 parts by weight of chlorin.
4. One part of hydrogen plus 35.46 parts of chlorin equal 36.46 parts of hydrochloric acid by weight.

EQUATIONS:

What is an *Equation?* What is a *Reaction?* These are questions which have probably come up to numerous readers.

When we speak of a Reaction, it is meant for some definite chemical action which takes place between two or more molecules, but the term is also used for an Equation. *An equation stands for a reaction.* It represents a chemical experiment.

As stated before, symbols and equations, together with certain algebraic signs are the shorthand of chemistry. An equation gives the substances that are put together in an experiment, and those which are

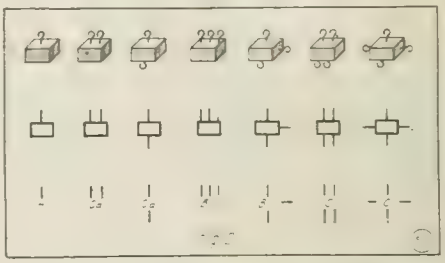


Fig. 2. The Several Ways of Representing "Valence." The Usual Method Involves the Use of Blocks With 1, 2 Or More Hooks Arranged As Shown In the Upper View.

obtained as a result, together with the right ratio of those used and of the ones obtained.

FACTORS AND PRODUCTS:

The substances put together for a given experiment are called "factors," and those obtained the "products."

If one contemplates advancing himself in chemical knowledge, it is imperative that he know how to write equations. There are three essentials to be mastered by the student. (1) to know the *factors* and their symbols; (2) to know the *products* and their symbols; (3) to balance the equation.

(*Note*:—A list of the elements, together with their symbols with atomic weights was given in the last lesson, page 559).

(1) FACTORS:—The first thing to do is to write down the symbols of the substances which were put together to obtain the result. Thus, in making Iron sulfid, we must first write down the symbols for the substances to be put together, namely, Fe and S. These two substances compose the first half of the equation and should be written: Fe + S =.

The symbols of the factors are always written on the left hand of an equation,

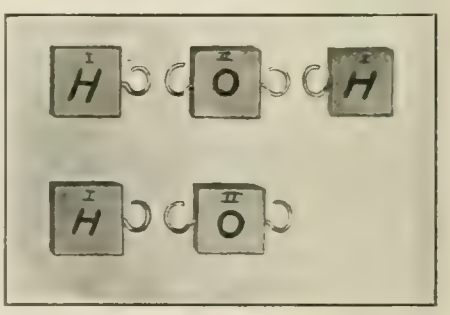


Fig. 3. Upper Line Shows a Bivalent Or Dyad Element—Oxygen (O) In Water H_2O. Lower Line Shows Why the Symbol for Water Could Not Be HO. There Would Be a "Free" Hook Or Bond.

and the number of factors are variable. Sometimes we use only one factor, *i.e.,* breaking up Red Oxid of mercury (HgO); or two or more factors, in an experiment.

(In the preparation of hydrogen, water was employed merely as a solvent of the

(*Continued on page* 636)

WITH THE AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief and use only one side of the sheet Address the Editor, "With the Amateurs" Dept.

Send a Photo of Your "Electrical Lab."

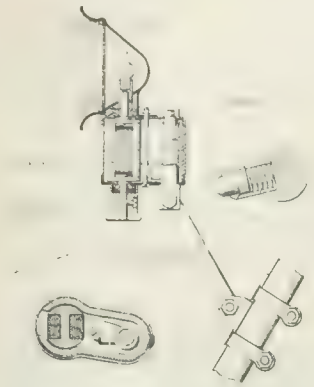
"Radio-bugs," just keep up the good work! Send us a photograph of your "Electrical Laboratory" now so that we can judge them for the February prize contest. You might as well take a chance on winning the monthly prize as well as anyone else. Talking about prizes, we want to speak particularly about this month's prize winner—Mr. Edward G. Raser, of Trenton, N. J. Now Mr. Raser has a genuine "Electrical Lab." No mistake—"Bugs." Among other things he owns a Wheatstone bridge, a Potentiometer, two D. C. Galvanometers, Kelvin bridge for measuring extremely low resistances, Millivoltmeter, a Standard Cell, a Pyrovolter, etc. He also has two resistance furnaces which lie on the floor at the right and cannot be seen in the picture. He uses 220 volts and steps it down to 50 volts by means of a large transformer and can melt brass, copper, tin and lead with the aforementioned apparatus. An electric arc run from the same source of supply is used for welding purposes and obtaining high temperatures. Address your "Electrical Lab." photos to Editor "With the Amateurs Prize Contest."

A GROUP OF REPRESENTATIVE AMERICAN AMATEUR LABORATORIES.
Electrical Laboratories of, 1—Edward G. Raser, Trenton, N. J.; 2—Richard S. Owen, Pittsburgh, Pa.; 3—J. F. Freeman, Tucson, Ariz.; 4—Harvey McCoy FitzSimmons, Mansfield, Ohio; 5—Harold Martin, Pasadena, Calif. Radio Stations of, 6—Earl S. Nelson, Cleveland, Ohio; 7—Ted Lively, Morrison, Ill.; 8—Sedric R. Brown, Oceanside, Calif.; 9—D. E. Barthel, Elkader, Ia.; 10—Theodore Gathmann, New York City; 11—Fonda McCook, Sumner, Ia.; 12—C. H. Langford, London, Ont., Canada.

LATEST PATENTS

Bicycle Lamp
(No. 1,244,262; issued to H. R. Van Deventer.)

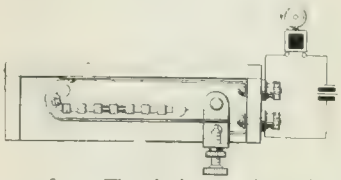
Those who ride bicycles will be interested in this ingenious dynamo headlight which is arranged to be driven by frictional contact between its driving pulley and the tire on



the bicycle wheel. The details are very simple, there being provided a permanent-magnet type dynamo, which can be swung into contact with or away from the bicycle tire. The dynamo shaft carries on its upper end a suitable receptacle for the low voltage lamp, and the latter therefore rotates with the armature, giving a very efficient illumination.

Gas and Smoke Alarm
(No. 1,242,575; issued to Silvestro Milano.)

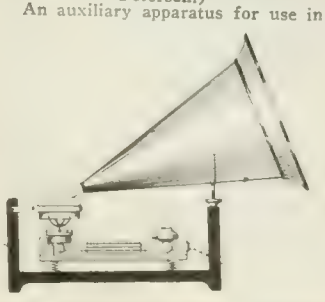
Many lives have been lost annually from smoke and gas escaping in dwellings. The present device is of great interest therefore, in that it will give an alarm from gas, smoke



or fire. The device consists of a circuit maker and breaker embodying a thermostatic spring responsive to abnormal temperature changes, together with means sensitive to the presence of illuminating gases, so that when subjected thereto said means will generate heat, as is the case by using for the purpose spongy platinum. If gas happens to escape into the room, this element will become heated to a glowing condition, whereby it will influence the thermostatic spring, and thus close the alarm circuit, which may be either audible or visual.

Telephone Amplifier
(No. 1,243,755; issued to F. C. C. Naeser and N. A. J. Lilliendahl-Petersen.)

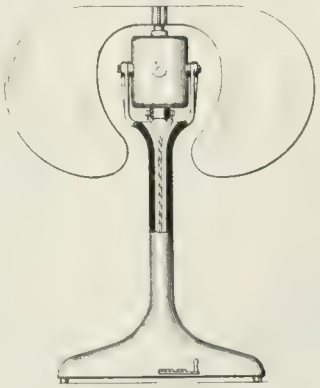
An auxiliary apparatus for use in



connection with regular telephone equipment, providing amplifying means so that one or more persons may readily hear the telephone speech without placing the instrument to their ear or ears respectively. The device comprises a sounding-box with a suitable membrane and contact member which will rest against the diafram of the telephone, when the latter instrument is properly placed on a spring table as shown. This receiver to accommodate the telephone instrument is made resilient by placing the springs under it, and when this part of the apparatus is properly adjusted, the speech can be heard very plain and strong thru the trumpet, all disturbing sub-tones and by-tones being eliminated by the transmission of the sound waves thru the sounding-box, so the patentees claim.

Unique Electric Fan
(No. 1,243,238; issued to Angelo Adamo.)

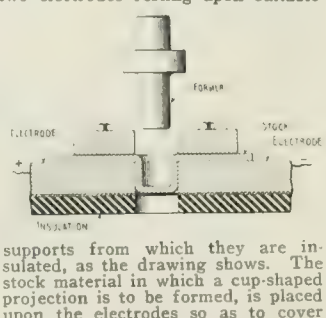
An electric fan of the portable type, the object of the invention be-



ing to provide a fan which will deliver a current of air from all sides or to all quarters of a room or apartment, whereby a thoro circulation of air may be secured thruout all portions of the room without requiring the fan itself to be oscillated or revolved in the ordinary manner. Further, the patent provides for a vertical motor, and especially devised fan blades of novel form, whereby the air will not only be moved in a circular path, but also forced outwardly for reliable and efficient circulation.

Electrical Punch Press
(No. 1,242,580; issued to T. E. Murray, Jr.)

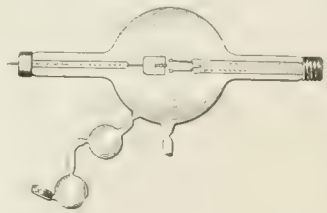
This idea combines a mechanical punch press operation with electrical means for heating the piece of material to be shaped so as to simplify the process. The device comprises two electrodes resting upon suitable



supports from which they are insulated, as the drawing shows. The stock material in which a cup-shaped projection is to be formed, is placed upon the electrodes so as to cover the central opening and is secured by clamping bars and bolts. The punch is supported above the plates in any suitable manner to permit vertical motion. The stock plate being clamped in position on the electrodes, the current is establisht of sufficient strength to heat and so soften the portion of the plate which covers the central opening. The punch is then lowered and caused to force the softened metal into the die opening. When the collar on the punch meets the two die clamps, the current is short-circuited thru the former, so that its heating effect upon the metal then ceases, permitting the metal to quickly solidify.

Electron Discharge Bulb
(No. 1,244,217; issued to Irving Langmuir.)

Electron discharge device suitable for rectifying alternating currents, etc., and having an electrode consisting at least in part of "thorium," and having at a given temperature, an electron emission per unit surface



materially greater than the emission of a refractory metal, such as Tungsten, at the same temperature independently of and in the absence of positive ionization. The patentee provides in the glass envelope a quantity of a vaporizable reagent of low vapor pressure capable of preventing the oxidation of "thorium," using for this purpose an alkali metal such as potassium.

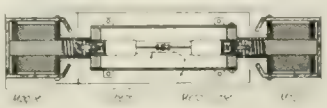
Secret Telegraph
(No. 1,244,477; issued to Patrick B. Delany.)

The patentee has here devised a clever telegraph sounder circuit whereby it is possible to cause the sounder used in public telegraph offices to give "reverse" signals and in this way to prevent any one in the vicinity of the instrument from deciphering the actual incoming message, which is taken from another sounder close to the operator. The sounder which is connected to give the reverse signals is mounted in a wooden resonator, so that they

will predominate in loudness over the signals recorded by the main sounder. This is accomplisht by providing a back contact on the line relay.

Coherer-Protector
(No. 1,242,512; issued to Harry D. Betz.)

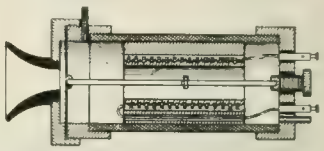
A clever arrangement for protecting wireless coherers from the powerful currents produced by the local transmitting apparatus or other nearby electrical disturbances. The invention comprises a metallic case for inclosing the coherer to exclude undesired waves therefrom, two contart members normally located within the case and adapted for contacting the coherer terminals and means for withdrawing the contact members from the metallic case a sufficient distance. To insure against the coherer being affected by Hertzian waves or the like during a protective period, the contacting members are operated by means of two electric magnets at either end of the

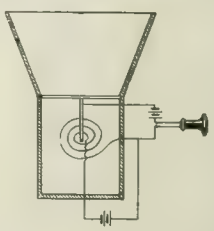


device, and which control magnets may be connected with the local transmitting key, aerial switch, etc.

Improved Microphone
(No. 1,244,150; issued to E. Weintraub.)

A microphone capable of carrying and modulating a much larger current than has been possible in this class of apparatus heretofore. This increase in resistance variation in the present device has been affected by raising the electrodes or current-varying medium to a high temperature, the passage of current between electrodes being facilitated when their temperature, is raised, owing to the greater emission of electrons. These electrodes moreover work best in a vacuum or in a rare gas such as "argon." Concentric with the microphone-members, there is placed a cylindrical coil forming an electric heater. The ends of the microphone electrodes are formed so that one of them may contain granules of carbon for example, or for a high resistance microphone—metallic oxids, and the end of the other electrode is properly designed to hold these granules in place. Variations

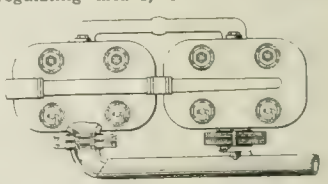




of current thru an external circuit are thus caused by microphonic action at this heated electrode juncture, which current variations may be transformed and made to operate a second circuit for wireless or submarine signaling purposes, etc.

Thermo-Electric Generator
(No. 1,242,499; issued to Hartwell W. Webb.)

The principal object of this invention is to produce a thermo-electric generator which is particularly adapted for utilizing the waste heat of the exhaust gases of internal combustion engines. The patent also provides a thermo-electric generator with automatic electric potential regulating means, etc. Instead of



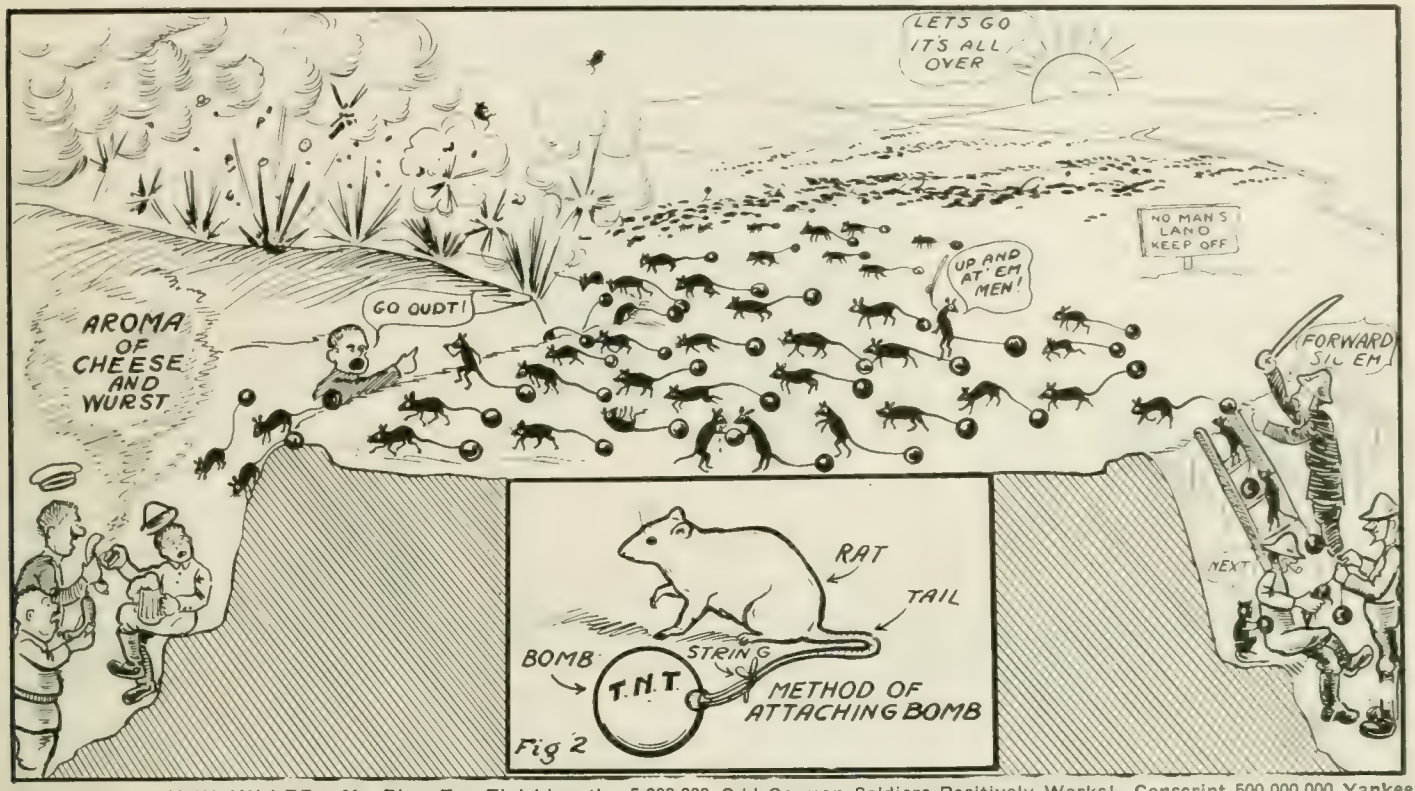
soldering the two opposite metals of the thermo-couples, which are liable to become loosened in service and thus reducing the efficiency of the device, the present thermo-couples, having for instance iron as the positive elements and an alloy of nickel and copper as the negative elements, are interfused at their joints by electric spot-welding. This form of thermo-couple construction has been found to be very efficient. To form a generator unit of several couples, and to hold the elements in place, a suitable impervious heat-conducting and electric insulating binding material is used, such as a cement.

Phoney Patents

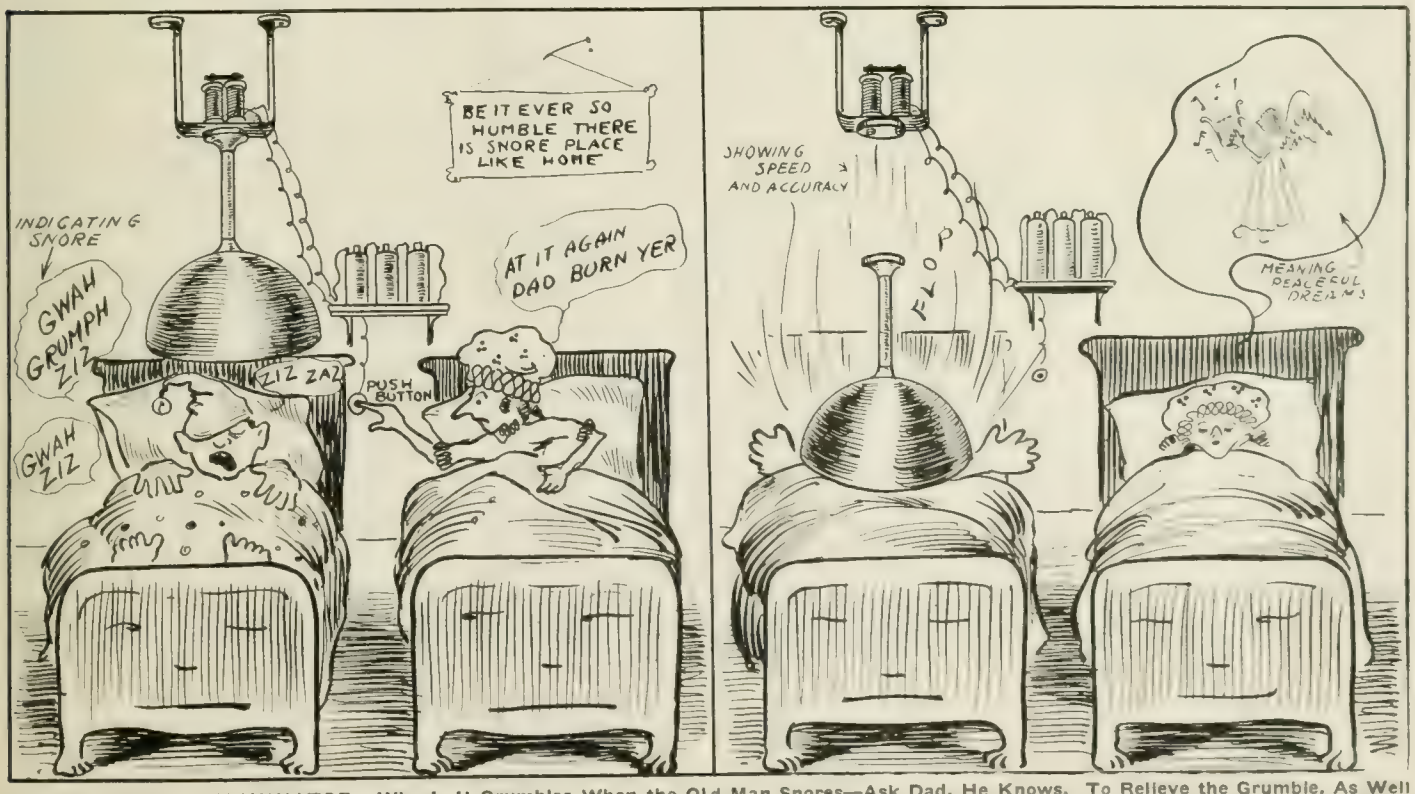
Under this heading are publisht electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00!! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ



Prize Winner. HUN KILLER. My Plan For Finishing the 5,000,000 Odd German Soldiers Positively Works! Conscript 500,000,000 Yankee Rats (100 to a Hun); Then Manufacture 500,000,000 Electric Bombs. Toward Dawn of the Psychological Day Attach a Bomb to Each Rat's Tail. The Aroma of Limburger and Wurst Attracts the Rats; the Electric Time Fuses Let Go; the Bombs Explode Simultaneously; Presto! No More Germans. Inventor, Gust Ekonom, Springfield, Ill.



ELECTRIC SNORE ELIMINATOR. Who Is It Grumbles When the Old Man Snores—Ask Dad, He Knows. To Relieve the Grumble, As Well As the Snore, Waste No Time In Installing This Extremely Simple Electric Device Which Stops the Snore Instantly and Without Pain. The Annoyee Pushes the Button; the Gravity Cell Current Opens; the Magnet Thus Releases the Snore Dome. Simple? You Bet! Inventor, Jack Dodge, Sydney, N. S. Can.

QUESTION BOX

This department is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

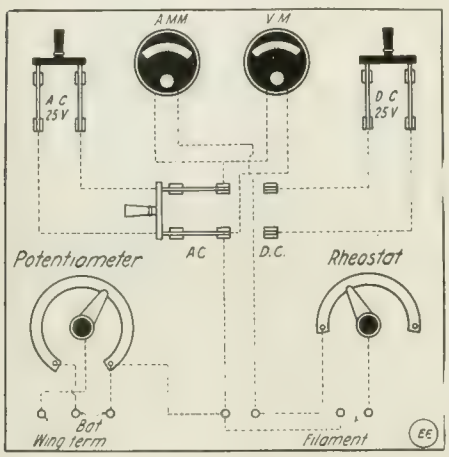
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions address to this department cannot be answered by mail free of charge
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

WIRING DIAGRAM.

(874.) M. F. Kelley of Meadville, Pa., says:

Q. 1. I wish to connect up the instruments shown herewith to a small switchboard. Will you give me a diagram of the wiring?

A. 1. We give complete wiring diagram of your instruments.



Hook-Up For Audion Testing Switch-Board Adapted to Laboratory Requirements.

RADIUM EMANATION.

(875.) John Alexander of Brownsville, Texas, wishes to know:

Q. 1. How can radium emanation be detected?

A. 1. Radium emanation or that emitted by radio-active compounds are usually detected by means of the *gold-leaf electroscope,* which is a very sensitive instrument for the detection of these minute electronic discharges emitted by such radio-active substances.

Q. 2. What is the construction of a spinthariscope?

A. 2. The general make-up of Crooke's spinthariscope is usually composed of screen coated with a very high-grade phosphorescent zinc sulfid, and a small pin opposite. A short distance away from the phosphorescent screen there is placed a minute speck of radium, the emanations from which cause the zinc sulfid to become phosphorescent. The whole arrangement is placed in a tube, one end of which is fitted with a magnifying lens, so as to intensify the scintillating particles shot out from the screen.

EINTHOVEN GALVANOMETER.

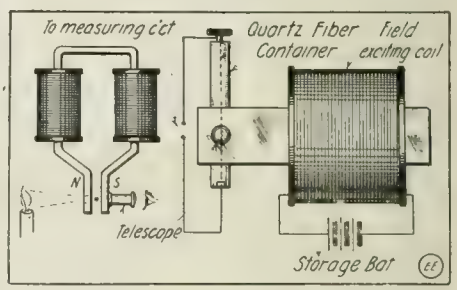
(876.) Arthur Stanley of Flushing, L. I., wishes to know:

Q. 1. The construction and operation of an Einthoven galvanometer?

A. 1. The general construction of an Einthoven galvanometer is shown in the sketch herewith. It will be noted that two strong magnet poles with a very small air gap are used. The magnetic flux between these poles is very high, and is obtained by the use of two powerful electro-magnets as indicated. These are excited by a direct current, usually obtained from a series of storage batteries. The reason for using storage batteries as a source of supply is that of obtaining a powerful unidirectional and constant current. The current obtained from a generator is by no means unidirectional, but contains a series of pulsating peaks due to the commutator action of the machine.

In the small air gap of the magnet a fine silver-plated quartz filament is inserted, the ends of which are properly suspended and connected to the source of current which is to be measured. In one of the pole-pieces of the electromagnet a telescope eye-piece is inserted, which is used for noting the degree of displacement of the quartz wire that takes place.

The principle of operation of this device is solely dependent upon the displacement of the quartz filament in the magnetic field. The degree of displacement of this filament is proportional to the amount of current which flows thru it, and the density of the magnetic field in which it is placed. This type of instrument is very sensitive, and the standard type usually is so sensitive that the filament will be displaced one millimeter for every one-ten-thousandth of an ampere. These instruments are so sensitive that they may be utilized for the reception of radio signals.



General Make-Up of Student's "Einthoven" String Galvanometer.

These galvanometers have also been utilized to a great extent for the study of heart diseases in human beings, and a description of their use for this purpose is thoroly described in the May, 1917, issue of the ELECTRICAL EXPERIMENTER.

ODD PHOTOS WANTED AT $1.00 EACH!!!

Now is the time to make your Kodak pay for itself in a real practical way. We are after interesting photographs of out-of-the-ordinary electrical, radio and scientific subjects and are willing to pay $1.00 *cash for every one we can use. Please bear in mind that for half-tone reproduction in a magazine, a photograph should be particularly sharp and clear. Of course, if a subject happens to interest us particularly well, we can have the photo retouched. For the general run of subjects, however, it does not pay to go to such expense. Therefore, please take pains to properly focus and expose your pictures. It often happens that a really mediocre subject well photographed wins approval over an excellent subject poorly photographed. And don't send us plate or film "negatives"; send unmounted or mounted "prints," perfcrably a light and a dark one.*

As to what to photograph: Well, that's hard for us to say. We leave that up to you, and every reader now has the opportunity to become a reporter of the latest things in the realm of Electricity, Radio and Science. But, please remember—it's the "odd, novel or practical stunts" that we are interested in. Every photo submitted should be accompanied by a brief description of 100 *to* 150 *words. Give the "facts"—don't worry about the style. We'll attend to that. Enclose stamps if photos are to be returned and place a piece of cardboard in the envelope with them to prevent mutilation. Look around your town and see what you can find that's interesting.*

Address photos to—Editor "Odd Photos," ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York City.

MULTI-LAYER COILS.

(877) D. L. Latley, Westmount, Can., wishes to know:

Q. 1. Are one or two coils used for the construction and use of the Inductances mentioned in the article entitled "Calculation and Measurement of Inductance" in the September, 1917, issue of the EXPERIMENTER? If so, are they the same?

A. 1. You can use as many of these multilayer coils in the circuit as you wish, as the electrical conditions of these coils are just the same as those of the single layer coils. There is absolutely no difference between these coils and the ones used at the present time.

Q. 2. How is coupling varied?

A. 2. The coupling between two multilayer coils is varied in the same manner as that of the single layer type, the only difference between the coils, both of the receiving and exciting types, is that the multi-layer coil contains several layers of winding instead of one.

Q. 3. Do all the layers begin at the same side of coil?

(*Continued on page* 632)

Columbia Grafonola

Music by Electricity

THE Grafonola which operates by electricity and requires no winding, is rapidly growing in favor.

The electric motor of the Columbia is a marvel of accuracy and precision. It operates perfectly on any standard direct or alternating current; just attach plug to socket. It holds the tone true. No trouble about the motor going "dead" in a Columbia Electric Grafonola. The first time you hear an electrically operated Columbia you will want to own one.

You can purchase a Columbia Electric Grafonola for $135, $145, $185 or $240 at any store where Columbia Grafonolas are sold. Convenient payments may be arranged.

COLUMBIA GRAPHOPHONE COMPANY
NEW YORK

WIRELESS

The Government and Merchant Marine need thousands of trained operators now, the demand far exceeding the supply. Men are needed urgently for the Naval Reserve, Aviation & Signal Corps, Marconi Co., etc.

Pick your rating before you are drafted.

Special short code courses, Day or Evening, for Government Service. Students from all over the country. Send in your enrollment today. Classes now forming.

The Eastern Radio Institute is endorsed by the U. S. Government & Marconi Co.

EASTERN RADIO INSTITUTE

899B Boylston St. Boston, Mass.

Don't Fail to Read the Notice on the Front Cover Explaining how to Re-mail this Magazine to our Soldiers and Sailors at the Front.

A Real Model Dirigible Airship

Five Foot Complete Airship, $1.00.

Every Outfit complete with large parachute, Dropping Apparatus and equipped with inflating arrangement. Every outfit guaranteed to fly ONE HALF MILE AND DROP PARACHUTE FROM APPROXIMATE HEIGHT OF 500 FEET. Airship made from Fabric Tissue, may be flown numbers of times with a complete Exhibition at each flight.

IT WILL AMAZE YOU!

Price, $1.00. Canada and Foreign, $1.25.

U. S. WAR KITE. CLOTH PLANES, ADJUSTABLE SIDE AILERONS, PARACHUTE AND RELEASING DEVICE.

This Kite is of the Biplane Type and will carry aloft Parachute and Model Bombs at same flight, drop them safely and with remarkable precision.

Satisfaction Warranted.

Price, $1.50. Canada and Foreign, $1.75.

TAUBE LOOP-THE-LOOP RACING AIRPLANE.

Complete Light Weight Racing Model—Looks and Flies like the Big Machines. Will Loop-the-Loop or fly Straight 200 Feet.

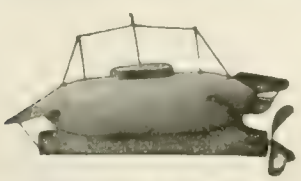
EACH OUTFIT COMPLETE WITH LAUNCHING DEVICE.

Price, 50c. Prepaid.

SUBMARINE—AN ACTUAL DIVING MODEL.

May be used in bathtub or at the seashore. Will return to surface at completion of each cruise. Cannot be Lost. Aluminum Propeller and Budders. The Finest Thing for Christmas.

Price, Securely Packed, $1.25.



THE AERO COMPANY, Dept. 40. BINGHAMTON, N. Y.

QUESTION BOX.

(*Continued from page* 630)

A. 3. It is not necessary that all layers of the coil begin at the same side of the winding, but can be a continuous winding, such as those employed in electro-magnets.

GROUND BATTERY.

(878) Mr. L. E. McQueen, Elkhart, Ind., asks:

Q. 1. Please explain to me how I can make an *earth battery*, and what the voltage will be, and can I increase the voltage by laying more than one, and connecting them together, as any other cell.

A. 1. An earth battery can be made by inserting zinc and copper or carbon electrodes in the earth, preferably in a place where the ground is very moist, so that electro-chemical action will take place between said plates; thus producing an electromotive force in the external circuit.

The voltage of such arrangement is very low, usually below one volt. However, the amperage of such a cell can be increased by increasing the total exposed area of the elements. They can be increased by either increasing the size of the inserted elements or by connecting several of these elements in parallel.

This type of cell is very inefficient and very clumsy. However, where currents of small magnitude are required at a cheap cost, you will find that such a cell will be of service.

It is advisable that the space between negative and positive plates should be filled with a layer of charcoal, which should be at all times saturated with a weak acid solution or a saturated solution of salt. This will be found to give satisfactory results.

ELECTRICAL QUERY.

(879) John W. Powers, Dawson, Ill., writes us:

Q. 1. A straight bar of copper, for example, cutting across a magnetic field, has a potential difference established between its ends, excepting a slight displacement current at the start. No current would flow until the electrical circuit was completed. Now the question is: Does it require the same force to move the bar of copper across the magnetic field when the ends are not connected and the electrical circuit was completed?

A. 1. As soon as the external circuit of the revolving copper strip is closed when moving in the magnetic field a difference of opposite potential is established in the circuit which tends to overthrow the originally produced electromotive force. This naturally produces a mechanical strain in the revolving armature which necessitates a greater amount of power to revolve it at a given speed, in order that the desired external electromotive force can be generated.

STEP-DOWN TRANSFORMER.

(880) S. C. Vaughan, Boonville, Mo., sends drawings of a rectifier and wishes to know:

Q. 1. Can this arrangement be successfully used to operate ¾" spark coil and small series-wound motors?

A. 1. The arrangement of employing a rectifier in conjunction with a step-down transformer is possible. The rectified current thru the transformer would again be converted into a sinusoidal current when passing thru the transformer.

Further, you can operate satisfactorily a ¾" spark coil with this arrangement or run a small motor, providing that the step-down transformer is sufficiently large to deliver the proper secondary current to operate the device. About 2 amperes will be required to run either of the two mentioned apparatus.

TELEGRAPHY, by T. E. Herbert, A. M. Inst. E. E.; cloth bound, 985 pages, size 5 x 7¼"; Third Edition thoroly revised and enlarged with 630 illustrations. The Macmillan Co., New York City. Price $3.50.

The third edition of this book far surpasses expectations. The work covers the entire field and the reviewer finds it impossible to describe in detail the many interesting and instructive chapters—a most concise and detailed exposition of the telegraph system of the British Post Office.

Among the subjects treated we find:—Fundamental principles of magnetism and electricity; units; primary cells; calculations in connection with circuits and conductors; the resistance of wires; the measurement of current and E.M.F.; battery testing; potentiometer measurements; measurement of resistance; single current systems and relays; capacity; condensers; the double current sounder; the differential duplex; the quadruplex; the wheatstone automatic system; the bridge duplex; the wheatstone A.B.C.; the Steljes recorder and Rebesi typewriting telegraph; the Hughes; the Baudot; the Murray automatic and Murray multiplex systems; central battery telegraphs and telegraph switching systems; secondary cells; repeaters; the test box and protective devices; telegraph testing and the formation of special circuits; construction of aerial lines; construction of underground lines, etc., etc.

Besides these numerous chapters there is an Appendix covering the theory of Magnetism, a very lengthy discourse on Chemistry; Automatic Printing Machines; Wire Gages, etc.

The author has dealt in a very increasing way with all the subjects and describes each apparatus and its function in the simplest manner possible. The standard method of using these instruments is explained in a most up-to-date manner in each case, and this work should find a ready demand from the student as well as the more advanced worker.

TEXT BOOK ON WIRELESS TELEGRAPH, By Rupert Stanley, B. A.; cloth bound, 340 pages; 5¾ x 8¾"; Longmans, Green & Co., New York City; Price $2.25. Second Edition.

Prof. Stanley's work is one of the best works on the subject of Radiotelegraphy as yet presented to the art. It fills a distinct want and every reader of this book will certainly enjoy the brilliant way in which every subject is handled, and moreover, reap real benefit from it.

The author has done his work well and in writing the work has always held in mind the special requirements of elementary students. Beginning with the rudimentary principles, he carries the student on step by step until he knows each subject thoroly.

All the important radio phenomena, experiments and calculations are carefully explained, a series of questions at the end of each chapter acting as a review and home examination.

Many drawings and photos of commercial apparatus are incorporated in the work with full explanation of each—the appendix contains code charts, call letters, rules and regulations, radio time service and other important data.

Taken as a whole, the work is very complete; especially is this true of the chapters on undamped wave systems, which is of special interest at the present time. Prof. Stanley knows whereof he writes, having been instructor in the subjects he treats on for many years in one of the best English universities.

WIRELESS MUSIC TO ARMY CAMPS.

Troops in many encampments within a radius of about 100 miles from Forty-third Street and Broadway, New York, recently heard the strains of a single phonograph, playing martial airs in a wireless tower at that point.

Among the encampments connected with the phonograph were those at Yaphank, Hempstead, Wrightstown, Sea Girt, Plattsburg, Van Cortland Park, and many small outpost stations where soldiers are guarding bridges and public works.

The experiment was conducted with a phonograph especially constructed for army use by Thomas A. Edison. The idea is to use similar machines in France, where one, placed in a dugout behind the lines can send "canned" music over the telephone to soldiers in front line trenches on a wide front.

"ELECTRICIAN-RADIO, U. S. N."

(*Continued from page 612*)

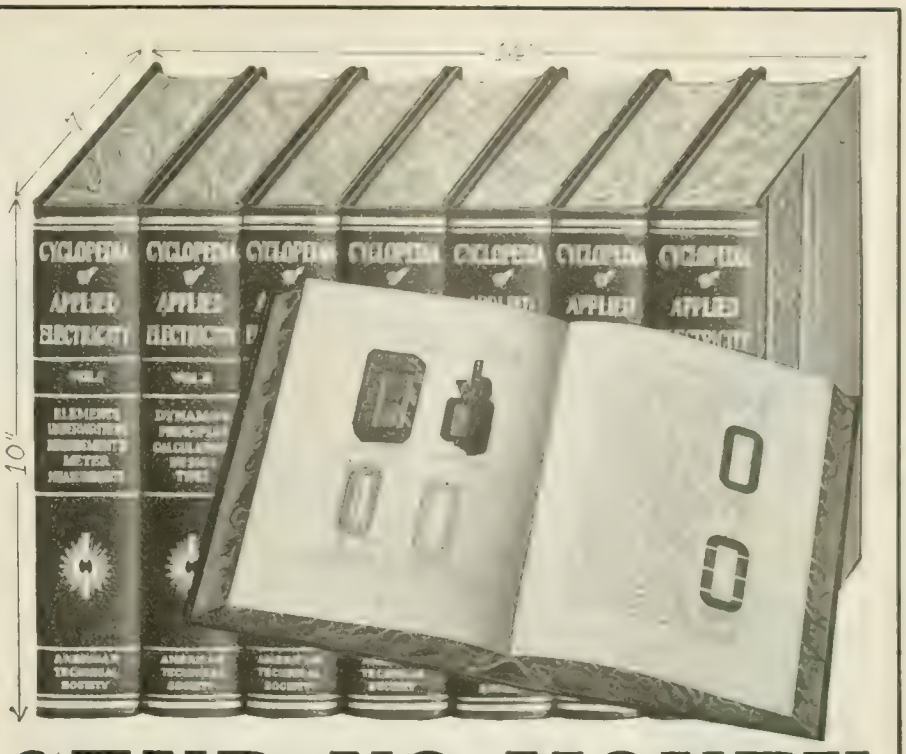
sea to get his training, to serve his apprenticeship. There is no denying that some youths hesitate to join the Navy because they find it hard abruptly to quit home and be stationed three to ten thousand miles distant. Suppose, however, they are sent to a naval training school only a day or two away from their native village, so that at the discretion of their Commanding Officer they may get leave for a brief visit at home —what then? Does not that situation banish all scruples of the reluctant, thus permitting them to break into their new life more gradually? Moreover, a man is never in the service a month before he is ready and anxious to sail to the end of the earth with the fleets. Homesickness makes short headway under the skin.

A training station for sailors is in full operation in the unsaltiest state in the Union—Minnesota. And though the men from the Mississippi valley are especially acquainted with Dunwoody Naval Training School, Minneapolis, bluejackets are there from every corner of the land, and three-eighths of the entire detachment is studying electricity, general and radio. When training is being given in twelve branches, and there are nearly a thousand bluejackets being instructed at a time, the relative consequence of the electrical crafts is at once evident.

Ensign Colby Dodge, U.S.N., Commanding Officer of this remotest naval station from the ocean, has from the outset insisted that the electrical courses be given extreme thoroness, the same as at the old-establisht electrical schools at New York and Mare Islands Navy Yards. When the offer of Dunwoody to train apprentices was accepted last summer by the Navy Department, the first move of this state industrial school was to send its chief instructor in electricity to that very Navy Yard in New York, where after weeks of concentrative observation at the famous electrical school he mapt out a course for his prospective pupils, a plan of work completely in accord with naval stresses, precedents, and regulations. He figured on a wartime schedule of four months' instruction for his electricians-general, and unlike most of the other instructors who have revised their courses to three, five, or eight months, he has found his calculations about right. Now, December, the first company of one hundred Dunwoody-trained naval electricians has departed for sea duty, and the winter quota of apprentices has just begun to wrestle with batteries and generators. Radio operators, besides, have been leaving Dunwoody at the rate of about thirty a week since early in September.

Naturally it became immediately necessary to supplement the equipment already in the electrical shops of Dunwoody with many additional appliances, some essentially naval and some not. The instructor learned at the navy yard that the marine electrician is up against much apparatus and gear with which the landsman is unfamiliar. In order that the reader may obtain a precise idea of what the Dunwoody bluejackets study it may be interesting to recount some of the mechanism which was specially installed by the time the men began training.

Upon reporting the urgent needs to the Bureau of Steam Engineering the following were received at Dunwoody: Motor control equipment, signal devices such as arc lights, incandescent searchlights, yard-arm blinkers and portable tube blinkers; interior communication devices, such as push buttons, connection boxes, bells, ship annunciators and buzzers, gun elevating motors, motor parts, circuit breakers, motor starting apparatus, light and power fixtures such as deck fixtures with globes, ceiling appur-



SEND NO MONEY

USE THESE ELECTRICAL BOOKS SEVEN DAYS AT OUR EXPENSE

By merely filling in and mailing the coupon below you can get this complete set of the Cyclopedia of Applied Electricity *on trial.* Use these books for seven full days before you make up your mind whether or not you want them. If you keep them, you may pay the special advertising price in easy installments of $2.00 a month. If you don't want them, you may send them back at our expense and you won't be out a penny. Remember, we pay the shipping charges both ways.

A MASSIVE ELECTRICAL LIBRARY—NOT HANDBOOKS

These seven splendid volumes contain all the knowledge you need in order to earn big money in the electrical field. They are not thin handbooks, but thick, encyclopedia-size volumes, handsomely bound in half red morocco leather, gold stamped. Each one measures 7 by 10 inches, and is 2 inches thick.

This big size permits the use of large and comprehensive illustrations, plates, diagrams, etc. Over 3,000 cuts are contained in the Cyclopedia's 3,500 pages.

The completeness of the Cyclopedia will be a revelation to you. Everything electrical is explained in plain, simple English—every technical point is made clear. Each volume is carefully cross-indexed for instant reference.

Read These Subjects

Elements of Electricity—Electrical Measurements—Underwriters' Requirements—Theory, Calculation, Design and Construction of Generators and Motors — Dynamo-Electric Machinery—Lighting Machinery—Power Transmission—Electric Railways—Power Stations — Switchboards and Switching — Storage Batteries—Applied Electro-Chemistry — Electric Elevators—Electric Welding and Heating — Wire and Wireless Telegraphy.

50c a Week For this sum—an insignificant one—this wealth of electrical information is yours. But you don't have to send us a penny until you have used the books for seven days. Then, if you decide to keep them, send only $2.00 a month—***50c a week***—until the special advertising price of $19.80 has been paid. The regular price of these pay-raising books is $35.00.

Consulting Service Free

A year's Consulting Membership in the American Technical Society—regular price $12.00—will be included with all orders for a limited time. The advice of an entire corps of electrical experts is yours to help you in your progress—for a whole year **FREE!**

Send No Money—Just the Coupon

See these books for yourself before you buy. Remember, you don't risk a penny or assume a single obligation. The books will be sent by prepaid express to any one within the boundaries of the United States or Canada, and they may be returned at our expense if they fail to please. But you must act now! This generous offer cannot be continued indefinitely. Send the coupon now.

AMERICAN TECHNICAL SOCIETY
Dept. E-7441 CHICAGO, U.S.A.

American Technical Society
Dept. E-7441 Chicago, U.S.A.

Please send me the Cyclopedia of Applied Electricity for seven days' free examination. If I decide to buy, I will send you $2.00 in seven days, and the balance at the rate of $2.00 a month, until $19.80 has been paid. Then you will send me a receipt showing that the set of books and the $12.00 consulting membership are mine and fully paid for. If I think that I can get along without the books, I will return them after seven days, at your expense.

Name.....

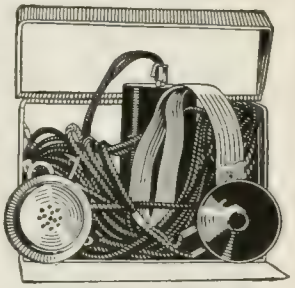
Address.....

Reference.....

Junior Deaf-Phone For People With Impaired Hearing **$15** Complete

THE MICROPHO JUNIOR DEAF-PHONE is a super-sensitive instrument which has been developed to meet the demands for a practical and efficient hearing device at an extremely low price. It is equal to any $35.00 instrument made and superior to most of them.

The outfit consists of One Super-Sensitive Transmitter with cord connector; One Super-Sensitive Ear Piece with small black cord; One Black Single Headband; Black Case and Two Batteries.



IMPROVED

Super-Sensitive Microphone Only $7.50

This instrument is offered at an extremely low price. It is excellent for building your own radio amplifier. Can also be used in many experiments where a sensitive microphone is required.

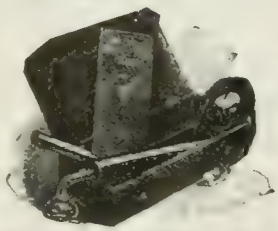
NEW DETECTAGRAPH $15

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25 ft. Black Cord, Receiver, Headband, Case and Battery.

DETECTAGRAPH $15

Send for one Today and Convince Yourself

MICROPHO-DETECTOR COMPANY
Gaston Boissonnault, President
26 Cortlandt St., NEW YORK
Makers of Super-Sensitive Microphone Apparatus



Electricity Heals Wounded Soldiers

In the military hospitals of Europe, where the surest, safest and most modern methods of healing are employed, wonderful results have been obtained by the use of the

STERLING VIOLET RAY GENERATOR

The instruments used are the same as those being sold for home and hospital use all over the world. They can be used wherever there is an electric lamp socket. Simple in operation—a child can use one safely. Treatments from 5 to 15 minutes produce results no medicine can obtain. Combines benefits of High Frequency Electricity, Vibration, and Oxidation.

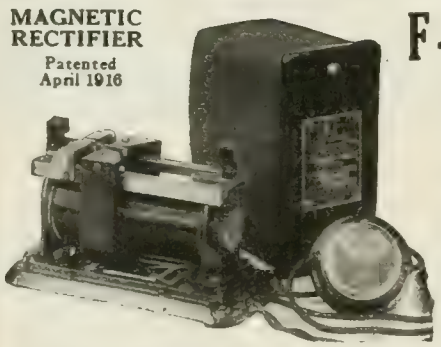
DEALERS SHOULD WRITE PROMPTLY

The fame the STERLING VIOLET RAY GENERATORS have won in the camps and hospitals of Europe has increased the demand for them the world over. We are allotting territory to distributors in order of application. Illustration shows Generator which retails at $17.50, complete as shown. Weight 20 ounces. Smallest efficient Violet Ray Generator ever built. Other types and prices. Never equalled in scientific and practical comparison. Largest line and manufacturers in the world.

Free Literature and Special Introductory Offer. Agents Wanted in all open territory.

THE STERLING ELECTRICAL CORPORATION
BRANCHES IN ALL PARTS OF THE WORLD
Church Ave., Cor. West 28th St.
CLEVELAND, OHIO, U. S. A.

MAGNETIC RECTIFIER
Patented
April 1916



F-F BATTERY BOOSTER

CHARGE YOUR OWN BATTERIES

For Public or Private Use

A battery undercharged is rapidly on the down grade and you'll soon be in for heavy expense in buying a new one. Our "Battery Booster" occasionally attached to your alternating current lamp socket in garage, will keep your battery in tip-top shape. Charges at night while in your car.

Ask your dealer or write for Bulletin No. 12.

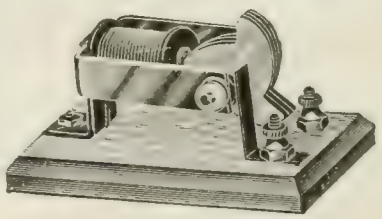
$18 Complete, and up

F. O. B. Cleveland.

THE FRANCE MANUFACTURING CO., Cleveland, Ohio

BOYS, LOOK! A REAL Electric MOTOR **50c**

Some hummer. Develops wonderful power. Will run your Erectors, Meccanos, etc. Works on 1 to 6 dry cells, storage battery or A. C. transformer. Mounted on hardwood base. Has ¼ in. grooved pulley. On two cells you can hardly stop it with your finger. Runs all kinds of toys. Has nickeled steel frame and copper armature. Put 50 cents in stamps in an envelope.



FREE A 3½ volt tungsten flashlight lamp if you order at once.

Use Coupon Below. *Return mail will bring you Motor*

C. D. WOOD ELECTRIC CO., Dept. 24, 441 Broadway, New York City.

SIRS: Send me a MONOCOIL Motor. Enclosed find 50 cents.

Name .....

Address .....

tenances, distribution and junction boxes, and 5-ampere switches and receptacles.

In the Dunwoody electrical shop a huge instrument board was at once set up bearing all the small instruments and appliances commonly used aboard a dreadnaught. Next to this board was hung a panel six feet square, a white panel with black letters half a foot high—you've guesst it,—the eternally paramount Ohm's Law. That formula, *I equals E over R,* relentlessly stares every bluejacket in the face from six to nine hours each day. When he leaves Dunwoody he knows that cardinal law of electricity in all its ramifications, knows it just as certainly as he knows when pay day comes around, and that's almighty certain. No less intimately is he acquainted with every instrument on the adjacent panel. No bell, no buzzer, no connection box, but he knows its anatomy. He has to, or his coveted rating is denied him.

With the unprecedented rush of war orders during the past autumn it has not been easy to get quickly needed apparatus from manufacturers, even by Government direction. However, in fairly good time for teaching the first detachment of sailor-electricians, Dunwoody managed to obtain a mercury arc rectifier, two two-horsepower shunt motors, two one-eighth kilowatt shunt generations, one variable speed direct current motor, one automatic starting device with push-button control, one variable speed alternating current motor, one 10-kilowatt rotary converter, one switchboard converter, one set of voltage transformers, two seven and one-half K.V.A. alternators, one three-panel switchboard (D.C.), one voltage regulator and four auto-transformers. This additional equipment, together with what was supplied by the Bureau of Steam Engineering, rounded out a shop and laboratory pretty well fitted to train electricians worthy of Uncle Sam's fleets.

The Dunwoody electrical department has been peculiarly fortunate in having among other instructors two broadly trained ex-Navy men. Both enlisted in the Navy as seamen, second class. One came out chief electrician and the other electrician, first class. They know naval indoctrination, how to discipline recruits, the advantage of runing every phase of their courses on prompt schedule.

"It is not hard to get ahead in the Navy," said one of these men, who is now director of the Dunwoody radio classes. "The great mistake many bluejackets make is in trying persistently, obtrusively, to get a "pull" with their superior officers. If a man will just buckle down to his job and forget about bootlicking, recognition will come soon enough. Nothing queers a man so surely as too much 'pull.'

"When the radio apprentices arrive at Dunwoody," he continued, "I give them an entrance examination in common arithmetic and elements of electricity. If a student makes a fair mark he is put in the advanced class. If he is weak on decimals, fractions and square root he is given a few more lessons before starting the related work. The course as outlined covers sixteen weeks, half that period devoted to operating practise and the other half to classroom, lectures and laboratory. The operating room is fitted with tables and head phones to accommodate one hundred men at a time. Related work includes demonstrations and lectures in theory of motors, batteries and dynamos, also the theory, installation, construction, operation and repair of radio apparatus. Each student keeps a 'log' book in which he writes all he learns in class, and answers twenty questions on the work of each week. An operating examination is also given each week, to record sending and receiving ability in words per minute. Unless a man im-

Please mention this magazine when writing to advertisers

proves steadily he is classed a 'drone' and marked down. If he does not reach a receiving speed of fifteen words a minute after six weeks' training he is relegated to the 'drone division' and gets special instruction for two weeks. If he still displays no signs of ever becoming a radio operator he is send back to Great Lakes station to man a 'deck swab' instead of a wireless key. Under this system only *one or two men in a hundred* have shown inaptitude.

"The men are instructed on the navy type Audion receiving sets, as well as on the measurement of wave lengths and the adjustment of the modern arc and spark transmitters. In the operating room five long tables are divided into sections eighteen inches deep by twenty-four wide, each section equipt with a 'phone, jack, and key. Omnigraphs are used for sending, and keys for hand sending to any or all of the tables are mounted on the master table. Three tables are used for receiving only, two for both sending and receiving. On the sending tables two students sitting opposite can send to each other independently of anyone else. In this way men of equal operating ability can be paired off to work together until they attain ten or twelve words a minute. They are then transferred to the receiving table, and upon reaching fifteen words go to the 'traffic' table.

"Here each bluejacket is assigned a 'call letter,' and is required to carry on traffic with the master table in accordance with the traffic laws. Instead of a buzzer for producing the practise signals in the 'phones a high-frequency generator is used. This generator has ninety-eight poles, and the rotor which is the field is revolved at a speed sufficient to give a clear musical note of about 600 cycles. The head 'phones are connected directly thru the transmitting keys to the stator coils of the generator, which is driven by a one-sixth horse-power motor. The frequency as well as the strength of the signals can be easily varied, so the student gets practise in receiving an exact imitation of the modern radio signals such as are sent out by undamped wave generators and quenched spark sets."

This scheme of instruction and the arrangement of apparatus have been evolved by a man who was formerly a radio chief on U. S. S. Birmingham, one of the first ships in our navy to be rigged with wireless. He has grown up with the craft, the craft which has become literally a science among the most significant developments of this generation. Dunwoody radio men will go to sea ably tutored. After the war, either in the navy or in civilian appointments, their services will continue to be at a premium.

Indeed, not a few radio bluejackets were well-trained operators before they enlisted to aid their country in the present crisis. Such men, altho they gave up no mean "bounties" besides their salaries, realized that the advanced instruction they could obtain free in the Navy would enable them to get even better jobs in later life.

I have said that college men are often discovered amongst the recruits. In the hundred electricians-general sent to Dunwoody from the Mare Island Navy Yard and thru Captain Moffett at Great Lakes station, four have been found, all graduates of state universities—California, Arizona, Nevada, and Iowa. As is common with men who have gone thru college, their lack of information on practical problems has been noticed. But these four students are well versed in theory, they can teach, they can assist excellently in the laboratory, with experiments. It has been found expedient to divide the electricians into four sections of twenty-five each, and over each section one of these college men is to be retained at Dunwoody, each of the four designated assistant instructors for the new arrivals.

That these assistants and some other experienced students who have attained high marks may not cease gaining electrical knowledge, so that eventually they can win better ratings upon going to sea, the chief instructor in the department has set aside Saturday mornings to give them advanced work. As for the preceding five days of the week, all electricians get six hours of training daily, with two two-hour study periods in the Institute at night.

A general survey of the Dunwoody course in electricity indicates that the work comprises six distinctive parts: Magnetism and wiring, motors and generators, instruments and switchboards, storage batteries, lamps and searchlights.

To mention less generally some of the subjects covered, there may be cited splicing, soldering, taping; annunciators, conduits and telephone circuits; micrometers and solenoids; motors and control; galvanometers, dynamos, shunt motors and armatures; candlepower, lighting circuits, Wheatstone's bridge, voltmeters, etc.

Tho in the electrical work-shop at Dunwoody the bluejacket has bench exercises and learns to make small apparatus on drill-press and lathe, it must not be supposed that his instruction is confined solely to that department. Before he leaves for sea duty he is made well acquainted with the machine-shop, gas-engine laboratory, and forge.

Hello Boys!
REG U.S. PAT. OFF.

You know I never put anything on the market until I'm sure it's the best of its kind. I wouldn't risk losing the friendship of the tens of thousands of you boys who know from experience with Erector and my other toys that I always put the finest stuff into everything I make. Well! **The**

GILBERT
CHEMISTRY OUTFIT

is no exception. It's one of the finest outfits ever manufactured for junior chemists. Some of the best known chemists of the country tell me they never saw anything that begins to compare with it.

If you're going to get a Chemistry Outfit—and every boy should who likes scientific things and loads of fun—be sure to get the Gilbert Chemistry Outfit. It's the only one that enables you to generate your own electricity through chemistry.

It is the only one having a wet cell and equipment for electroplating and nickel plating.

With the Gilbert Chemistry Outfit, you learn a lot about the wonderful science of chemistry, and your friends will marvel at your ability. You can make soap, disappearing ink, make an egg pass through the narrow neck of a bottle, replate spoons, knives and forks and do countless other wonderfully interesting and mystifying things.

A large, beautifully printed manual, containing an elementary course in chemistry, is included in each set.

Your local toy dealer should have this set in stock. If he hasn't write us and we'll tell you who has. Price $3.00 (Canada $4.50)

Mail back the coupon today for a free copy of my magazine for boys' "Gilbert Toy Tips," which explains all about my other toys and the Gilbert Engineering Institute for Boys.

A. C. Gilbert
President.

Mr. A. C. Gilbert, Pres.
THE A. C. GILBERT CO.,
160 Blatchley Ave.,
New Haven, Conn.

Please send me a copy of "Gilbert Toy Tips" which tells all about my Chemistry Outfit and the "Gilbert Engineering Institute for Boys."

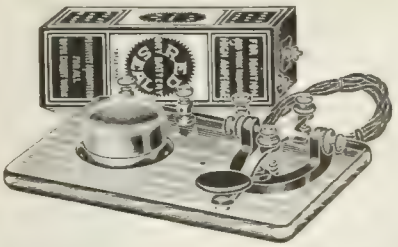
Name
Street
City
State

The A. C. Gilbert Company, 160 Blatchley Avenue New Haven, Conn.

CANADIAN REPRESENTATIVES, Menzies & Co., Limited, Toronto, Ont

MescoTelegraphPractice Set

For Learning Telegraph Codes

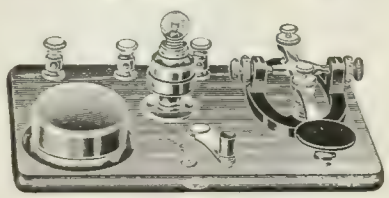


The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green silk covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No. Price
342. Telegraph Practice Set, with Battery and Cord.....$2.70

MESCO Combination Practice Set for learning the Morse and Continental Visual and Audible Codes



This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord, $3.38

Send for the New Edition of Our Catalog W28 Ready about Dec. 15

It is pocket size, contains 248 pages, with over 1,000 illustrations and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Telegraph Material, Electric Toys, Burglar and Fire Alarm Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

Send for the Catalog Now

Manhattan Electrical Supply Co., Inc.

New York: 17 Park Place | Chicago: 114 S. 5th Ave. | ST. LOUIS: 1106 Pine St.
San Francisco Office: 604 Mission St.

ELECTRICITY

All basic truths and principles made clear and fully demonstrated

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

"Learnelectrics"

Complete Electrical and Experimental Laboratory

A choice collection of instruments, materials and interchangeable parts with which numerous electrical machines may be constructed and a thousand experiments performed.

Together with a very valuable

INSTRUCTION BOOK

by H. P. Gorman, A.I.E.E., profusely illustrated and covering entire subject. Outfit enclosed in attractive box with fittings for every part.

$2.75 all leading dealers

If your dealer cannot supply you order direct. Or write for free catalog of electrical motors and specialties from 10c up.

KNAPP ELECTRIC & NOVELTY CO.
523 West 51st Street, N. Y. City

The new classes of electricians-general starting their training at Dunwoody in December will spend their first two weeks mostly in the machine-shop, learning to operate big lathes, planers, shapers, milling machines and mill-cutters, even to the radial drill-press, the grinder, and the emery wheels.

Later, in the gas-engine department, the bluejacket electricians are familiarized with simple and compound reciprocating engines, with separators, traps, indicators, tachometers, pressure regulators, and the various valves, condensers, pumps, gages and revolution counters. This work, of course, provides for much time to be given to the practical operation, assembly and repair of such mechanism, lining up engines, overhauling pumps and regrinding valves.

In the longer period necessarily devoted to things more intrinsically electrical, it is not possible to give electricians as comprehensive a course in gas and steam engines as the motorboat pilots themselves are getting at Dunwoody, nor in machine tools and appliances as the machinists are learning, nor yet in oxy-acetylene welding and forging as the blacksmiths have, but the general electrical students do master the rudiments, and for that reason they are entitled to the term "general." They are without doubt the all-round handy men on a battleship. In Commanding Officer Colby Dodge of Dunwoody Naval Training Station, they have a mentor and disciplinarian who books no rated man's despatch to service in the first line ships until that man's class record is proven "unqualifiedly meritorious."

THE X-RAY ON THE BATTLE FRONT.

(*Continued from page* 599)

after the first exposure. A stereoscopic plate holder for exceptional cases, in which two exposures are better made upon separate plates, finishes the equipment.

Manipulation:—The distinctive lead marker is fastened to the skin where it will be in contact with the middle of the plate while the picture is made. The position of this is marked upon the skin with an indelible pencil. The plate is laid upon the table and the wire netting covers it. The lead serial number is invariably placed over the lower external corner of the plate. And the same number had better be marked upon the skin with an indelible pencil. Lead markers R and L (right and left), will be of occasional service. For the thigh or any part of the head or trunk, the anti-cathode is set at a distance of 21 inches from the plate, and is displaced laterally three inches after the first exposure. For the forearm or leg, the distance from the anti-cathode to the plate is fourteen inches and the lateral displacement of the anti-cathode two inches. Each $^1/_7$ inch subdivision that the image of the foreign body is displaced in either case, corresponds to ½ inch distance from the plate to the foreign body when the exposures were made. If this distance is considerable, we must bear in mind the fact, that the foreign body is located in a direction from one image to the corresponding position of the anti-cathode. Each exposure should be made of the same intensity and duration as for a single picture, whether the exposures are made upon the same or separate plates.

EXPERIMENTAL CHEMISTRY.

(*Continued from page* 626)

zinc chlorid formed, and for this reason it was omitted. In those experiments where water is employed solely as a solvent, it does not appear in the equation. Heat is also left out from equations).

(2) PRODUCTS:—*The products are the substances obtained as the result of an experiment.* These may be one or several. In the experiment with iron and sulfur, there was one product, iron sulfid. The equation may be written:—

$$\underset{\text{Factors}}{Fe + S} = \underset{\text{Product}}{FeS}$$

In other experiments two or more products may result from a given reaction.

The symbols of the products of an experiment are always written on the right of the equation. The equality sign is employed to separate the factors from the products. It is much more difficult to determine the products of an experiment, than to find the factors. At the outset we have to accept statements that this or that substance is formed, as when we are told that zinc chlorid is the resulting product from pouring hydrochloric acid on zinc. We might, however, as has been repeatedly done, have tested the substance, and have found the statement true.

In all cases where we are certain that a given reaction takes place, the products have been at some time ascertained, and in doing the experiments it is well to apply tests to as many as possible. But in a large number of cases we have to accept the statements of those who have made careful analysis of the results. It thus becomes necessary at first to memorize the factors and the products. It will be found very easy, after a little practise, to calculate the most common reactions. If a double decomposition takes place, the metal (or positive part) of each compound joins itself to the non-metal (or negative part) of the other. On mixing the solutions of silver nitrat and sodium chlorid there are formed sodium nitrat and silver chlorid: $AgNO_3 + NaCl = AgCl + NaNO_3$.

Sometimes one metal sets free another from a compound, the former taking the place of the latter. In a solution of silver nitrat, copper will displace the silver, deposit it, and form copper nitrat: $Cu + 2AgNO_3 = Cu(NO_3)_2 + 2Ag$.

Do not for a moment think that every equation that you can write stands for a reaction. Before an equation is written it must be known whether a given reaction will take place. For example: $2NaCl + H_2O = Na_2O. + 2HCl$ **IS NOT CORRECT,** for on mixing the two substances, *there is no such reaction.*

VARIATION OF EQUATIONS:

There are very few equations that express all that takes place in an experiment. The most they can do is to give the general average of reactions. Difference of temperature, strength of reagents, as well as different kinds of reagents, all contribute greatly to the variation of results. An excellent example is the action of nitric acid on metals. The general equation is $8HNO_3 + 3M'' = 3M(NO_3)_2 + 4H_2O + 2NO_2$ M'' represents any metal, having a valence of two). But this varies greatly with (1) temperature (2) strength of acid, and (3) different metals. Often two equations are given to express results at dif-

ferent temperatures. *Molecular Equations*, as distinguished from *Atomic Equations*, contain no free atoms, but have all atoms combined as molecules. $H_2 + O = H_2O$ is an atomic equation: $2H_2 + O_2 = 2H_2O$ is molecular. As the molecular composition of most elements is not known, it is better to write atomic equations, tho many teachers advocate and even insist on writing H_2, Cl_2, O_2, never allowing the atom to stand alone.

EQUALITY SIGNS:

Sometimes the two parts of a reaction are joined by an arrow ($\leftrightharpoons$ or $\rightleftharpoons$) instead of the quality sign (=) as Fe + S ——> FeS. Often a reaction takes place one way under certain conditions, but under other conditions the reverse reaction results, as $2HI = 2H + 2I$, or $2H + 2I = 2HI$. The two may, in fact, happen in the same experiment. It is then customary to write it $2HI \leftrightharpoons 2H + 2I$ or, $2HI \rightleftharpoons 2H + 2I$, which is read, hydroiodic acid in equilibrium with hydrogen and iodin. Consequently the reaction often does not take place completely in either direction, so that all three substances may exist in equilibrium, side by side. The $\leftrightharpoons$ or $\rightleftharpoons$ signs always indicates a *reversible* reaction. For the present, it is better that the student employ the quality sign (=).

VALENCE:

What is **Valence?** *The valence of an element is the combining or replacing "value" of its atoms.* Valency is not an absolute invariable property of the element, but is dependent on the nature of the element combining and on physical conditions.

Dumas, in 1834, showed that 1 atom of oxygen had the same *replacing value* as 2 atoms of hydrogen, or 2 of chlorin. Liebig observed that hydrogen and potassium had the same value, which was only a third that of antimony. Frankland in 1852 first definitely explained the principle of valence, or the saturation capacity of elements. Frankland's valency theory was accepted by chemists in 1860. In 1864 Wurtz and Naquet establisht the fact that some elements show more than one valence.

If we compare a few symbols of compounds, we at once observe a certain numerical relation among their elements. By way of illustration, HCl, H_2O, H_3N, H_4C. One atom of chlorin unites with one of hydrogen; one of oxygen with 2 of hydrogen, one of nitrogen with 3 of hydrogen, and one of carbon with 4 of hydrogen. For practise compare the following in like manner:—

NaCl,	$CuCl_2$,	$BiCl_3$,	$SnCl_4$
NaBr,	$CuBr_2$,	$BiBr_3$,	$SnBr_4$
NaI,	CuI_2,	BiI_3,	SnI_4
NaF,	CuF_2,	BiF_3,	SnF_4

We see that sodium combines with chlorin, bromin, iodin, fluorin, in the atomic ratio 1:1. If bromin in sodium bromid were to be replaced, by chlorin, only one atom of chlorin would combine with one of sodium; in other words, chlorin has the same replacing value as bromin, or as iodin or fluorin. Sodium also has the same combining *value* as has each of the 4 elements named, and as has hydrogen. Copper (Cu) often has a different value. Its atom combines with 2 atoms of the elements named. Its combining value is twice as great as sodium, or as chlorin, bromin, iodin or fluorin, or hydrogen. It has a value of 2 if the others have a value of 1.

Valence has nothing to do with the strength or power of affinity. It is the combining (or replacing) *value*. An element having a valence of 5 has that combining value in the same way (as an analogue) a 50 cent piece has the same purchasing value that 5 dimes have. It can

ELECTRICITY

as the practical expert knows it

Learn electricity as you would in actual PRACTICE—in accordance with the methods employed by the highest paid electrical experts in America. The New McGraw-Hill Library of Practical Electricity contains the actual working facts which you need in order to succeed in the electrical field. Terrell Croft, formerly with the Westinghouse Company, makes the conquest easy for you. Read the course at home or slip a volume in your pocket for use on the job.

Not a correspondence course

This is NOT A CORRESPONDENCE COURSE—but a home-study course, complete in itself and thoroughly up to date. The set of 8 flexibly bound, pocket size volumes contains a complete electrical education which would cost several hundred dollars procured from any other source. You pay only $16 for the set complete —IN SMALL MONTHLY PAYMENTS. The coupon below entitles you to a free 10-day examination. Send it in at once.

TERRELL CROFT

Be guided in your study of electricity by an experienced Electrical Engineer of high professional standing. Terrell Croft, author of 7 of these volumes, climbed from the ranks to Electrical Engineer with the Westinghouse Company. He gained his knowledge with his sleeves rolled up and has met your problems in advance. He tells in plain, understandable language how to proceed by the best and most practical methods

Just issued, The New McGraw-Hill

Library of Practical Electricity

by Terrell Croft, formerly with Westinghouse

Easy Payments $2 per month Complete course 8 vols only $16

After examining the books under our 10-day free examination offer you will readily understand why students and electrical workers are so enthusiastic about the "Croft Library."

No amount of description can possibly outline to you the great importance of these new books in the electrical field today. You must see this flexibly bound Library and run through its 3000 pages and clear drawn illustrations before you can understand what it means to the student and practical worker. **The volumes cover Practical Mathematics, Practical Electricity, 2 Vols.; Electrical Machinery, Central Stations, Wiring for Light and Power, Wiring of Finished Buildings and Practical Electric Illumination.**

Examine this new Library and find out for yourself why they improve working methods and form a sure, short-cut to BIGGER PAY.

Easy Payments

Pay for the course as you go along. $2 per month for 8 months will give you a set of books which represents an achievement without parallel in technical literature. The terms are so easy that you can now easily afford a training which will prepare you in a short time to take a more responsible, better paid position.

Send the Coupon

The coupon above is for your convenience in examining these practical books. It obligates you in no way; on the other hand, it may easily mean permanent success for you in the well paid field of practical electricity.

Fill out and forward this coupon—and receive the entire 8 volumes by parcel-post or express prepaid for 10 days' free examination. If, after examining them, you are convinced of their power to help you to the highest positions in the field, send $2 in ten days and the balance at the rate of $2 per month until $16 has been paid.

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 239 West 39th St., New York

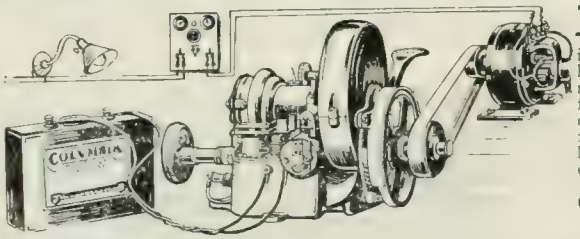
Gentlemen: Please send me the Library of Practical Electricity (shipping charges prepaid) for 10 days' free examination. If satisfactory, I will send $2 in ten days and $2 per month until $16 has been paid. If not wanted I will write you for return shipping instructions.

Name ..... Name of Employer ...

Home Address .. His Address ..

City and State ..... Your Position .....(Ex. Jan. '18)

"BRIGHTEST LIGHT"
NOVO PRODUCT
"LONGEST LIFE"
NOVO
FLASHLIGHTS and BATTERIES
"Your Best Friend in the Dark"
The Novo Triple Guarantee
which assures every user of a Novo Battery:
1. Absolute Non-Corrosion
2. Maximum Recuperative Power
3. Minimum Deterioration
Be sure to ask your dealer for NOVO. If he cannot supply you write to
Novo Manufacturing Co.
424-438 West 33rd St., New York, U.S.A.
Novo



THE "LITTLE PET"

is unquestionably *the* engine you have always wanted. Ideal to run small electric power plants, for charging storage batteries, electroplating for the laboratory, for the workshop, drive bench lathe, grinder, saw, washing machine, etc.

Operates on either gasolene or City gas.

Coil built into engine, countershaft and all gears safely housed. Ready to run when you unpack it, only battery to be connected. Any speed from 500 to 1400 R.P.M. can be had instantly, *while engine is running.* Step on foot pedal to start engine. Automatic oiling, no grease cups, an ideal home motor safe and dependable, will last for years. Cost to run 1½ cents per hour. Engine has 2" bore and 2" stroke. Gives over ½ H.P. Weight 60 lbs.

Price complete $33.00 | *Send for free catalog E.* **ELGIN GAS MOTOR CO., Elgin, Ill.**

STERLING ELECTRIC WATER PURIFIER

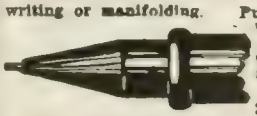
Brings a Crystal Spring to Every Home
Better than the Best Bottled Water Without its Cost.
Economy—Efficiency—Safety.
Some firms spend as much as $1,500.00 per year "trying" to get good drinking water—and fail.
Bottled water spoils in 24 hours being subject to a process of putrefaction, becoming stale and stagnant.

STERLING ELECTRIC WATER PURIFIER

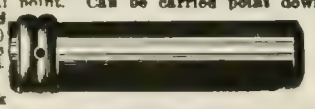
assures a perpetual supply of sparkling, crystal, clear, palatable, healthful water of unquestioned purity.
Its natural action is like strong sunlight, all germs are killed by it, unnatural odors and colors are removed, impurities are precipitated and the hardest water made soft.
It is self-sterilizing but may be readily cleaned.
For Factory, Theatre, Office, Home, Elsewhere. Money Savers and Health Preservers.
Free Literature and Spcial Introductory Offer.
Agents Wanted in All Open Territory.
THE STERLING ELECTRICAL CORPORATION, Church Ave., Cor. West 28th Street, Cleveland, Ohio, U. S. A.
Branches in all parts of the world.

A USEFUL MODERATE PRICE INK PENCIL

"Vulcan" $1.00 Ink Pencils



writing or manifolding. Pure Para rubber with precious metal point. Can be carried point down.
Made in red and black. Long and short. (Special! 8 ins., black, $1.25.)
Mail orders promptly filled. FREE supply of ink with retail orders. Agents wanted.
The only perfect non-leakable, will suit any hand. Guaranteed. Last a lifetime. Great for general



J. R. ULLRICH & CO., 27 Thames Street New York

combine with or replace 5 atoms of hydrogen or chlorin.

The combining value of the hydrogen atom is the unit of valence, as this element has the smallest combining value. Therefore its valence is said to be 1. In the molecule whose symbol is HCl the chlorin atom has the same valence as the hydrogen namely, 1.

If sodium and chlorin were brought together, each atom of sodium would combine with one atom of chlorin; Na + Cl = NaCl. If sodium and hydrogen chlorid (hydrochloric acid) should react, one atom of sodium would displace one atom of hydrogen: Na + HCl = NaCl + H.

In magnesium chlorid ($MgCl_2$) one atom of magnesium cannot combine with a single chlorin atom, but it picks out two atoms. If the compound were to be formed by the action of hydrochloric acid on the metal, the equation would be

$$Mg + \left\{\begin{matrix}HCl\\HCl\end{matrix}\right\} = Mg\left\{\begin{matrix}Cl\\Cl\end{matrix}\right\} + \left\{\begin{matrix}H\\H\end{matrix}\right\}$$

or, $Mg + 2HCl = MgCl_2 + 2H$. The valence of magnesium is therefore 2. In the chlorid of bismuth ($BiCl_3$), the bismuth atom cannot combine with one or two chlorin atoms, but is not satisfied with less than three. Formed from the elements, the equation would be $Bi + 3Cl = BiCl_3$; if made by the action of hydrochloric acid, $Bi + 3HCl = BiCl_3 + 3H$. Hence the valence of bismuth is 3. Now carbon requires four atoms of Cl to satisfy its attraction, and carbon chlorid is CCl_4. If the two elements could unite directly, the following would be the equation: $C + 4Cl = CCl_4$. If hydrogen could be obtained from carbon and hydrochloric acid, $C + 4HCl = CCl_4 + 4H$ would represent such a reaction. The valence of carbon is 4.

Any element which replaces hydrogen atom for atom, or any element which combines with hydrogen atom for atom, has a valence of 1, is said to be *univalent,* and is also called a *monad.* Thus the valence of chlorin in hydrochloric acid is 1. Note the valence of each of these elements, which are united with H: HBr, HI, HF. Any element combining atom for atom with one of these elements, F, Cl, Br, I, is also a *monad.* Note the valence of the first written element in these: NaBr, KI, AgCl, AgI, NaF. Elements which require two of these atoms to make a molecule of a compound have their valence 2, and are called *bivalent* elements, or *dyads;* for example, calcium in calcium bromid ($CaBr_2$). Note the name and valence of these metals: $CuCl_2$, HgI_2, $MgBr_2$. Write symbols for chlorids, bromids, and iodids of these *dyads;* Cd, Fe, Ca, Sr. The elements whose atoms select three atoms of a monad are *trivalent,* or *triads,* or their valence is 3; for example, As in $AsCl_3$. Write symbols of chlorids, bromids, and iodids of these triads: Sb, Bi, P, Fe, Cr, Al. A *tetrad,* or *tetravalent* element, has its valence 4. C and Si are the most important tetrads. A few elements are *pentads,* that is their valence is 5; for example, P, Bi, Sb. Try and write symbols for their *pentachlorides.* A higher valence than 5 is rare, though *hexads* and *heptads* are known.

DOUBLE VALENCE:

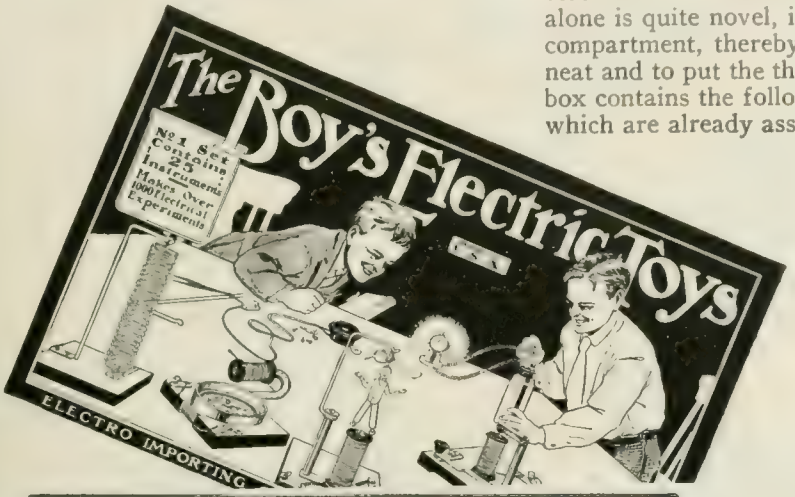
Elements quite often have more than one valence; for example, phosphorus sometimes combines with 3, sometimes with 4, atoms of chlorin. In the first case it is a *triad* (PCl_3), in the second a *pentad* (PCl_5). The iron atom under some conditions selects 2, under others 3, atoms of chlorin; as $FeCl_2$, $FeCl_3$. These are called,

(*Continued on page* 640)

"The Boy's Electric Toys"

There have been other electrical experimental outfits on the market thus far, but we do not believe that there has ever been produced anything that comes anywhere near approaching the new experimental outfit which we illustrate herewith.

"The Boy's Electric Toys" is unique in the history of electrical experimental apparatus, as in the small box which we offer enough material is contained TO MAKE AND COMPLETE OVER TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box construction alone is quite novel, inasmuch as every piece fits into a special compartment, thereby inducing the young experimenter to be neat and to put the things back from where he took them. The box contains the following complete instruments and apparatus which are already assembled:



No. EX2002

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat, erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. We lay particular stress on the fact that no other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver. Moreover this is the only outfit on the market to-day in which there is included a complete chromic acid plunge battery, with which each and everyone of the experiments can be performed. No other source of current is necessary.

Moreover, the outfit has complete wooden bases with drilled holes in their proper places, so that all you have to do is to mount the various pieces by means of the machine screws furnished with the set.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

The box alone is a masterpiece of work on account of its various ingenious compartments, wherein every piece of apparatus fits.

Among the finished material the following parts are included:

Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

All instruments and all materials are well finished and tested before leaving the factory. We guarantee satisfaction.

We wish to emphasize the fact that anyone who goes through the various experiments will become proficient in electricity and will certainly acquire an electrical education which cannot be duplicated except by frequenting an electrical school for some months.

The size over all of the outfit is 14 x 9 x 2¼. Shipping weight, 8 lbs.

No. EX2002 "The Boy's Electric Toys," outfit as described $5.00

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 19 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 228 Big Pages. 600 illustrations. 500 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 19 measures 7 x 5¼". Weight ½ lb. Beautiful stiff covers.

Now before you turn this page write your name and address on margin below, cut or tear out, enclose 6 cts. stamps to cover mail charges, and the Cyclopedia is yours by return mail.

THE ELECTRO IMPORTING CO.
231 Fulton Street, New York City

ELECTRO IMPORTING CO., 231 Fulton St., N.Y.

383 Experiments for every student in one year

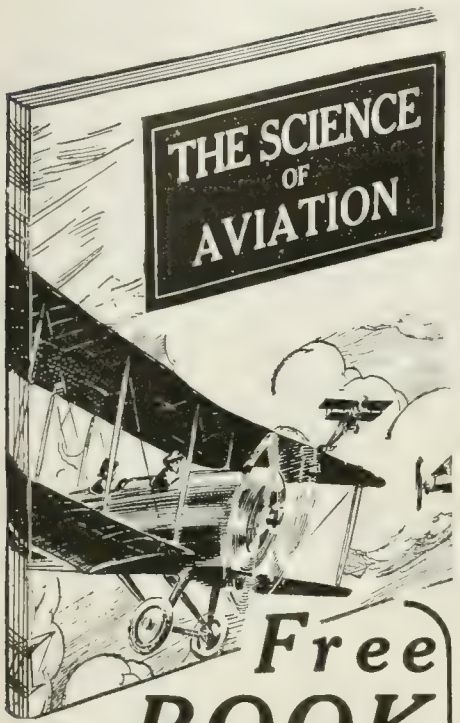
We train you to construct, install and operate actual electrical instruments and apparatus of every kind.

½ day instruction in our completely equipped laboratories and class-rooms and ½ day work in leading electrical concerns. One-year Course in Practical Electricity; Two-year Course in Commercial Engineering; Three-year Course in Electrical Engineering.

New Term Opens January 2

Write for free illustrated catalog. Mention age, education and course interested in.

SCHOOL OF ENGINEERING OF MILWAUKEE
366 Stroh Bldg., Milwaukee, Wis.



Free BOOK ON AVIATION

THE United States Government has appropriated $166,000,000 for new airplanes. Thousands of trained men are needed at once—men trained in the Principles and Mechanics of Aviation—men who can serve as airplane designers, builders, assemblers, repairmen, mechanics, inspectors, contractors and instructors. Will you heed the call? Our book tells of these opportunities and is sent you free—prepaid.

Trained Men Needed at Once

The Curtiss Aeroplane Company expects to increase its working force from 7,000 to 20,000 men. The Standard Aero Corporation, Plainfield, New Jersey, and hundreds of other factories are working night and day to supply machines. The airplane companies need a half a million men right *now*. The demand is tremendous. Did you ever stop to consider the wonderful possibilities offered ambitious men in the profession of Aeronautics? This new billion dollar industry will soon take its place along side of the automobile industry. Be a pioneer in this industry. You may be the future "Henry Ford" of Aviation.

Send the Coupon

Just put your name and address in the coupon right now and receive our free book about the Science of Aviation. We will tell you how you can learn at home the Principles of Aviation. Tear out the coupon and mail at once—before this offer is withdrawn. Do it right away—NOW.

National Aero Institute
Dept. 7441
Morton Building
Chicago, Illinois

Gentlemen: — Please send me absolutely free and prepaid your new book on the Science of Aviation; also particulars of your mail course in the Principles of Aviation and special limited offer.

Name . . . . . .

Address . . . . . .

. . . . . .

National Aero Institute
Dept. 7441
Morton Building
Chicago, Illinois

EXPERIMENTAL CHEMISTRY.

(*Continued from page* 638)

respectively, *ferrous* and *ferric* chlorids. *Ferrous* always indicates the lower salt, while *ferric* always indicates the higher, that is the combining value is 2 and 3 respectively. Occasionally elements have a certain valence towards one element and a different one towards another, but usually varying conditions of formation govern this peculiarity. When hydrogen and oxygen combine to form water the molecule is H_2O, and oxygen is a *dyad*. This valence of oxygen must be regarded as being as invariable as that of hydrogen. It is the standard of valence for negative or non-metallic elements.

HOW TO DETERMINE VALENCE:

How can I determine the valence of an element from the symbol of one of its compounds? What, for example, is the valence of Mg in MgO? Oxygen always has two bonds, and hence Mg must have the same number, as there is one atom of each in the symbol. To verify this, write the number of bonds above the element, with plus sign for that over the metal, and minus for the other.

$$\overset{+2}{(Mg''}\ \overset{-2}{O'')}.$$

In any symbol there must be as many "plus" bonds as "minus." A plus element may not necessarily be a metal, so long as it is plus with reference to the element it is combined with. There must be no free (or unsaturated) bonds; in order to form a stable compound all must be attached. This is imagined to explain why atoms of elements usually exist only in pairs; two hydrogen atoms, for example, attaching themselves together to form a stable molecule, H-H, or H_2. Now HO *is not* a correct symbol, for this would leave one bond free, H-O-, which attracts another H atom to saturate it, as H-O-H, or H_2O. The valence of N in N_2O may be considered 1, (N'_2O''), that is, 1 oxygen atom with 2 bonds is equivalent to 2 nitrogen atoms with 1 bond each. In N_2O_3 it is 3, since 3 atoms of O with 2 bonds each equal 6 bonds (N_2O_3''); and since 2 atoms have 6 bonds, 1 will have 3 bonds $(N_2''O_3'')$, or N is here a *triad*.

$$\overset{+2}{N}_2\overset{-2}{O}$$

$$\overset{-6}{(N_2O_3'')}$$

$$\overset{+6}{N_2''}\overset{-6}{O_3''})$$

Another good way to determine the valence of an element in a compound, such as Mg in MgO is as follows: We know that in water hydrogen has a valence of 1, but an exponent of 2 is used to indicate that 2 atoms of hydrogen are required to combine with 1 of oxygen, therefore oxygen has a valence of 2. This being the case Mg must also have a valence of 2 in order to combine with the oxygen. Likewise it can be remembered that Chlorin has a valence of 1, because it combines with 1 atom of Hydrogen as in HCl. Many other analogues may be found very useful for determining the valence of any element in a compound.

VALENCE OF RADICALS:

Radicals as well as elements have valence. In the compound HNO_3 the NO_3 radical has a valence of 1, because it combines with 1 hydrogen atom. In KNO_3 and $NaNO_3$, K and Na are each monads, as they replace H atom for atom, and the radical NO_3 is likewise univalent. Copper is a dyad. hence when it reacts with nitric acid, and displaces the hydrogen, it must displace 2 atoms, or combine with 2 NO_3 radicals, and the symbol of copper nitrat is $Cu(NO_3)_2$, as that of copper chlorid is $CuCl_2$. Silver nitrat is $AgNO_3$ and lead nitrat $Pb(NO_3)_2$. because the valence of silver is 1 and of lead is 2, while that of NO_3 is 1. Suppose lead were to replace silver in a solution of silver nitrat, the equation would require twice as many $AgNO_3$ molecules as of lead atoms.

$$Pb + 2AgNO_3 = Pb(NO_3)_2 + 2Ag$$

$$Pb + \left\{\begin{matrix}AgNO_3\\AgNO_3\end{matrix}\right\} = Pb\left\{\begin{matrix}NO_3\\NO_3\end{matrix}\right\} + \left\{\begin{matrix}Ag\\Ag\end{matrix}\right\}$$

EXERCISES:—In H_2SO_4 the SO_4 radical is united to 2 hydrogen atoms, and hence has a valence of 2. Potassium has the same replacing value, and hence the molecule of potassium sulfate is K_2SO_4 not KSO_4. The radical NH_4 has the same replacing value as H, hence ammonium sulfate is $(NH_4)_2SO_4$. Zinc is a dyad, and so 1 atom replaced 2 of hydrogen. Zinc sulfate is $ZnSO_4$. The reaction of zinc with sulfuric acid is $Zn+H_2SO_4=ZnSO_4+2H$. Triad elements uniting with dyad radicals give symbols as follows:

Al''' and $(SO_4)''$ is $Al_2(SO_4)_3$. Verification: $\overset{+6}{Al_2'''}\ \overset{-6}{(SO_4'')_3}$. Write symbols for these and VERIFY THEM: Na' and SO_4, $(NH_4)'$ and SO_4, Ba'' and SO_4, Mg'' and SO_4, Fe'' and SO_4. Fe''' and SO_4. Cr''' and SO_4, (The little characters like $(''')$ means the valence of the element is 3, etc.)

In phosphoric acid (H_3PO_4) it is evident that PO_4 is a *triad*. Replace the H with Na, and we have Na_3PO_4. Give a reason why it would not be $NaPO_4$. Write symbols for K' and PO_4, Ag' and PO_4, Ca'' and Po_4, Ba'' and PO_4, Mg'' and PO_4. Triads replace 3 atoms of hydrogen, as $FePO_4$, $CrPO_4$. In silicic acid (H_4SiO_4) what valence has the radical? Symbolize silicates of Na', Pb'', Ca'', Al''', and Sn^{IV}.

The principle above given enables us to ascertain the valence of the middle element of a triad, for example $KClO_3$. The valence of K being 1, of O 2, we have $K'\overset{+1}{Cl}\overset{-6}{O_3''}$. As there must be as many + as —bonds, Cl will have 5, as $+1+5-6$

TABLE

Metals and Positive Radicals				Non-Metal and Negative Radicals			
Monads	Diads	Triads	Tetrads	Monads	Diads	Triads	Tetrads
H	Mg	As	Pt	F	O	N	C
Na	Ca	Sb	Sn	Cl	S	P	Si
K	Sr	Bi		Br	SO_2	B	SiO_4
Ag	Ba	Au		I	SO_4	PO_3	
Hg	Pb	Fe		NO_2	CO_3	PO_4	
NH_4	Cu	Cr		NO_3	C_2O_4	AsO_3	
CH_3	Cd	Al		ClO	$C_4H_4O_6$	AsO_4	
C_2H_5	Zn			ClO_2			
	Co			ClO_3			
	Hg			BrO_3			
	Sn			IO_3			
	Fe			$C_2H_3O_2$			

$K'Cl^{v}O_3''$. Take $Pb(NO_3)_2$ to find the valence of N. $Pb(NO_3)_2 = PbN_2O_6$, $Pb''N_2O_6''$. There are 10 bonds left for N_2 or 5 for each N ($Pb''N^{v}O_6''$). Find the valence of N in KNO_2, in KNO_3; of P in Ag_3PO_4, in $Ca_3(PO_4)_2$.

Opposite is given a "table of valence," which should become familiar to the reader, and it is advised that they should try and memorize the main elements, and especially the radicals. It is indispensable, before proceeding further in the subject, that they be able to apply everything in this lesson. These elements and radicals are arranged according to the USUAL or more stable valence. The valence of most radicals does not vary, but that of many elements does.

STRUCTURAL SYMBOLS:—Molecules of compounds may differ in three ways. (1) In the KIND of atoms they contain. CO_2 and CS_2 are composed of carbon combined in one case with oxygen, in the other with sulfur. (2) In the number of atoms of the same element. CO and CO_2 are composed of the same elements, but with different proportions of oxygen. Hence the properties of the two compounds in this case are very unlike, as they were in the previous one. (3) In the arrangement of atoms in the molecule, *i.e.*, in MOLECULAR STRUCTURE. C_2H_6O is the symbol for either methyl ether or ethyl alcohol, two compounds of very unlike properties. From their similarity of composition, it might be supposed that their properties would be the same, but such is not the case. How can this difference be explained, when an exact analysis shows that the percentage of carbon, hydrogen and oxygen is the same in both? It is believed that the molecules are differently made up—that the carbon, hydrogen, and oxygen atoms are arranged differently in the ether and in the alcohol. That difference of place of atoms in molecules constitutes MOLECULAR STRUCTURE. Why is the symbol of ammonium hydroxid written NH_4OH and not NH_5O? Experiments show that one-fifth of the hydrogen bears a relation to the rest of the compound different from that which the other four-fifths bear. If we add a solution of ferric chlorid ($FeCl_3$) to the hydroxid, there are formed $Fe(OH)_3$ and NH_4Cl, as

(1) $FeCl_3 + 3NH_4OH = 3NH_4Cl + Fe(OH)_3$

A similar reaction takes place with aluminum, chlorid, etc.

A large number of other salts give hydroxids with ammonium hydroxid. It will be seen in equation (1) that Fe combines with OH and displaces NH_4, which unites Cl; that is, one of the H atoms is attached to the O atom, whereas to the four H atoms are joined the N. As this occurs in a large number of reactions, the symbol is written NH_4OH instead of NH_5O. In the reactions NH_4 unites with the negative elements or radical, OH with the positive.

The efforts of chemists to picture molecular structure, or the relative position of atoms in the molecule, has led to structural symbols. The EMPIRICAL SYMBOL of nitric acid is HNO_3. From the VALENCE SYMBOL ($H^{I}N^{v}O_3''$) the valence of nitrogen is seen to be 5. A SEMI-GRAPHIC SYMBOL IS H-NO_3, but the complete STRUCTURAL SYMBOL would be H-O-$N\begin{matrix}=O\\ \backslash O\end{matrix}$. The similarity to the symbol of water, H-O-H (in which NO_2 takes the place of the last H), is seen by comparing the two.

(*Continued on page* 643)

TRUSTFUL TELEPHONE OPERATOR.

I had an odd experience on the telephone a day or two ago, writes a correspondent of the London *Daily News*. After I had hung up I suddenly found that I had not got the necessary three pennies. I wanted to telephone badly, and explained my position to the girl. "Never mind," she said, "ring me up tomorrow and pay then." I tried to express my admiration of her trustfulness and to assure her that it was not misplaced. "That's all right, dearie," she said suddenly; *"I like your face!"*

I Can Succeed

"What other men have done with the help of the International Correspondence Schools, I can do. If the I. C. S. have raised the salaries of the other men, they can raise mine. If they have helped others to advance, they can help me. To me, I. C. S. means 'I CAN SUCCEED.'"

Make up your mind right now that not another day of this new year shall pass until you have made *your* start toward success. Simply say "I Will." The I. C. S. will come to you with the very help you need. Whether you're a dollar-a-day man, or a dollar-an-hour man, a long-hour man or a short-hour man—there's a better job ahead and the I. C. S. will prepare you to step into it.

No matter where you live, what you now do, or how little time or money you may have, the I. C. S. have a Course of Training to fit *your* needs.

Hundreds of thousands of ambitious men have achieved success through I. C. S. help in the past 25 years—over 100,000 are *now* studying, getting ready for the big jobs ahead. Join them and make your life something to be proud of—you *can* do it.

Mark and mail the coupon TODAY and find out *how;* it won't obligate you in the least.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 5366, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BOOKKEEPER
MECHANICAL ENGINEER	Stenographer and Typist
Mechanical Draftsman	Cert. Public Accountant
Machine Shop Practice	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	Common School Subjects
MINE FOREMAN OR ENGINEER	CIVIL SERVICE
Metallurgist or Prospector	Railway Mail Clerk
STATIONARY ENGINEER	Textile Overseer or Supt.
ARCHITECT	AGRICULTURE
Architectural Draftsman	Navigator
PLUMBING AND HEATING	Poultry Raising
Sheet Metal Worker	AUTOMOBILES
	Spanish
	German
	French
	Italian

Name _____

Occupation & Employer _____

Street and No. _____

City _____ State _____

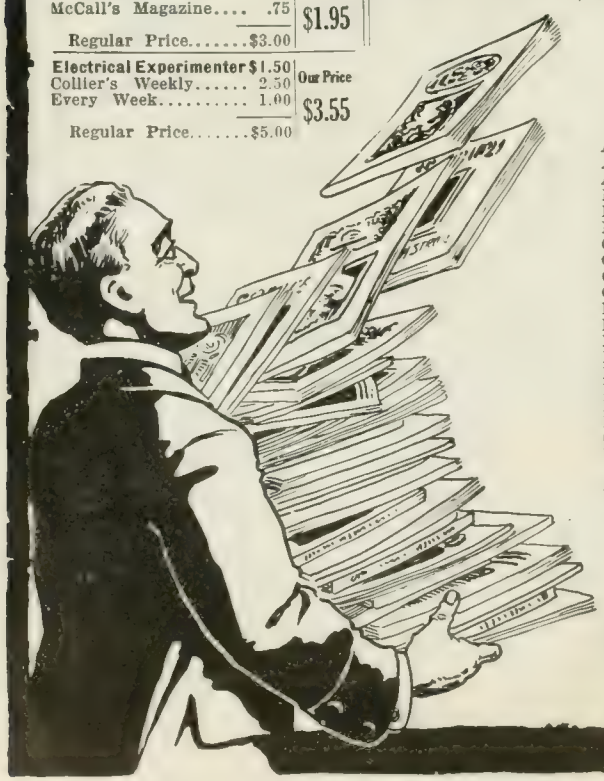
MAGAZINE-Prices Slashed

Millions of magazine subscriptions expire this month! With the tremendous advance of paper prices and labor it is certain that nearly all magazines will advance their subscription prices at least from 25% to 50%.

BY ORDERING NOW YOU WILL SAVE BIG MONEY.

In announcing these wonderful prices it is with the absolute knowledge that **our readers are offered the lowest prices for standard Magazines that it is possible to obtain anywhere.** Only by special arrangement with the publishers are these prices possible, but to take advantage of them, you must act quickly. **Don't delay, do it now.** This offer is so good that of necessity it must be limited in time. Just think of buying standard Magazines at reduced prices in time for Xmas Presents, and **they certainly make ideal gifts** being a constant reminder for a whole year of a considerate friend. Just glance over our wonderful prices, and see how **we enable one dollar to bring you two dollars' worth,** and then make up your list. When sending your order, don't forget to state **where magazines are to be sent. But be sure you do it now. To-morrow means you may forget** and lose this wonderful opportunity. All prices quoted are for subscribers in U. S. A. only, Canadian and Foreign subscriptions require additional postage.

The Publishers Will Mail the Magazine Direct From Their Own Office to You.

Electrical Experimenter $1.50 Popular Science..... 1.50 Illustrated World, (Technical World)... 1.50 Regular Price.....$4.50	Our Price	$3.40
Electrical Experimenter $1.50 American Boy..... 1.50 Boys' Magazine..... 1.00 Regular Price.....$4.00	Our Price	$2.85
Electrical Experimenter $1.50 American Boy..... 1.50 St. Nicholas..... 4.50 Youth's Companion.... 2.00 Regular Price.....$9.50	Our Price	$6.50
Electrical Experimenter $1.50 Today's Housewife.... .75 McCall's Magazine.... .75 Regular Price.....$3.00	Our Price	$1.95
Electrical Experimenter $1.50 Collier's Weekly..... 2.50 Every Week..... 1.00 Regular Price.....$5.00	Our Price	$3.55
Electrical Experimenter $1.50 Every Week..... 1.00 Regular Price.....$2.50	Our Price	$1.80
Electrical Experimenter $1.50 Boys' Magazine..... 1.00 Regular Price.....$2.50	Our Price	$1.75
Electrical Experimenter $1.50 Everybody's Magazine. 1.50 Delineator (all to one address) ..... 1.50 Regular Price.....$4.50	Our Price	$2.85
Electrical Experimenter $1.50 Motion Picture Magazine ..... 1.50 Regular Price.....$3.00	Our Price	$2.20
Electrical Experimenter $1.50 Delineator or Everybody's ..... 1.50 American Magazine... 1.50 Regular Price.....$4.50	Our Price	$3.50
Electrical Experimenter $1.50 Pearson's or Sunset... 1.50 Regular Price.....$3.00	Our Price	$2.25
Electrical Experimenter $1.50 World's Work..... 3.00 Regular Price.....$4.50	Our Price	$3.40
Electrical Experimenter $1.50 Outing ..... 3.00 Regular Price.....$4.50	Our Price	$3.65
Electrical Experimenter $1.50 Smart Set..... 3.00 Regular Price.....$4.50	Our Price	$2.90
Electrical Experimenter $1.50 Parisienne or Musician 1.50 Regular Price.....$3.00	Our Price	$2.25
Electrical Experimenter $1.50 Delineator or Everybody's ..... 1.50 Etude ..... 1.50 Regular Price.....$4.50	Our Price	$3.45
Electrical Experimenter $1.50 Youth's Companion... 2.00 Review of Reviews.... 3.00 Regular Price.....$6.50	Our Price	$5.15
Electrical Experimenter $1.50 Woman's Home Companion ..... 1.50 American Magazine... 1.50 (All to one address) Regular Price.....$4.50	Our Price	$3.30

Special Clubbing Prices of Electrical Experimenter WITH:

	Regular Price	Our Rate Per Year
Adventure	$4.50	$3.80
American Boy	3.00	2.25
American Magazine	3.00	2.30
Black Cat	2.50	1.85
Blue Book	3.00	2.40
Boys' World	2.00	1.45
Century	5.50	4.35
Christian Herald	3.50	2.65
Collier's	4.00	2.90
Country Life	6.50	4.65
Delineator	3.00	2.35
Etude	3.00	2.25
Everybody's	3.00	2.35
Farm & Fireside	1.75	1.35
Farm Journal (5 years)	2.50	1.80
Farmer	2.50	1.90
Field & Stream	3.50	2.65
Film Fun	2.50	1.85
Grit	3.50	2.75
Illustrated World (Technical World)	3.00	2.25
Judge Weekly	6.50	5.40
Ladies' World	2.50	1.75
Leslie's Weekly	$6.50	$5.40
Literary Digest	4.50	4.15
McClure's Magazine	3.00	2.25
Metropolitan	3.00	2.40
Modern Priscilla	2.75	2.15
National Magazine	4.50	3.15
Outing	4.50	3.65
Outlook	5.50	4.65
Pearson's Magazine	3.00	2.25
People's Popular Monthly	2.00	1.45
Popular Science Monthly	3.00	2.30
Red Book	3.50	2.85
Review of Reviews	4.50	3.15
Rural New Yorker	2.50	2.05
St. Nicholas	4.50	3.40
Scientific American	5.50	4.45
Scribner's Magazine	5.50	4.15
Smart Set	4.50	2.90
Wireless Age	3.50	2.65
Woman's Home Companion	3.00	2.30
World's Work	4.50	3.40
Youth's Companion	3.50	3.15

Write for Special Prices on ANY Publication not listed here

We will save you money

SEND ALL ORDERS TO "CIRCULATION DEPARTMENT"

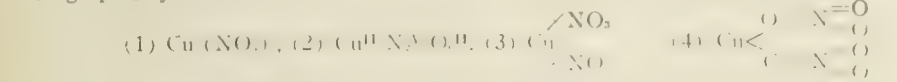
EXPERIMENTER PUBLISHING CO., Inc.

233 Fulton Street, New York City, N. Y.

EXPERIMENTAL CHEMISTRY.

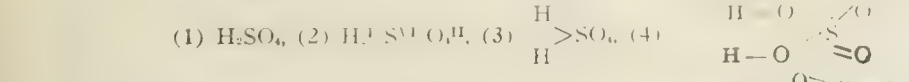
(*Continued from page* 641)

In the following examples (1) is the common or empirical symbol, (2) is what may be called the valence symbol, (3) is the semi-graphic, and (4) the structural or graphic symbol.

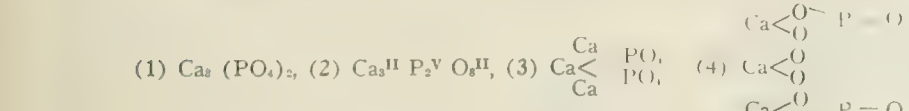


(1) $Cu(NO_3)_2$, (2) $Cu^{II}N_2^{V}O_6^{II}$, (3) $Cu(NO_3)_2$, (4) $Cu<\begin{matrix}O-N=O\\O-N=O\end{matrix}$

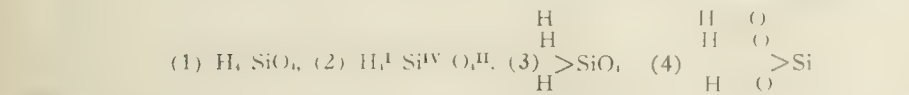
Note that Cu takes the place of 2 H in two molecules of HNO



(1) H_2SO_4, (2) $H_2^{I}S^{VI}O_4^{II}$, (3) H_2SO_4, (4) $H-O-S(=O)=O$



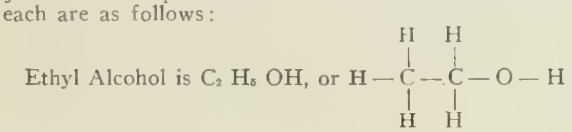
(1) $Ca_3(PO_4)_2$, (2) $Ca_3^{II}P_2^{V}O_8^{II}$, (3) $Ca(PO_4)_2$, (4) $Ca<\begin{matrix}O-P=O\\O-P=O\end{matrix}$



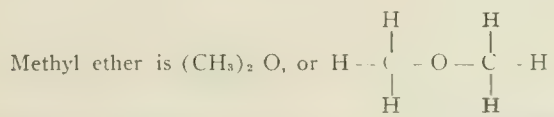
(1) H_4SiO_4, (2) $H_4^{I}Si^{IV}O_4^{II}$, (3) SiO_4H_4, (4) $Si(OH)_4$

ISOMERISM:—

Two or more compounds which have the same percentage composition of the same elements, but have different properties, are said to be *isomeric*. Ethyl alcohol and methyl ether, mentioned above, are examples, the latter being an *isomer* of the former. The symbols — empirical and structural — of each are as follows:

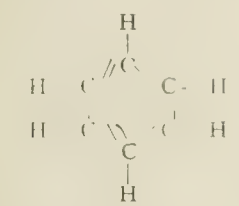


Ethyl Alcohol is C_2H_6OH, or $H-C(H)(H)-C(H)(H)-O-H$



Methyl ether is $(CH_3)_2O$, or $H-C(H)(H)-O-C(H)(H)-H$

Substances like the above, in which atoms are supposed to be placed differently in the molecule, are called METAMERIC. The other main variety of isomerism (besides metamerism) is called *polymerism*. *Polymers* have the same percentage composition, but the molecule of the polymer is a multiple of the other. Benzene (C_6H_6) is a polymer of acetylen (C_2H_2). The percentage composition is the same in both cases, but the molecular weight of the former is three times that of the latter. Structurally they are respectively H — C C — H, and



VALUE OF VALENCE:—

While the study of valence is of great importance to beginners in the science—so much so that symbols, equations, etc., cannot be understood without knowledge of the subject—yet the student must not attach the same value to the principles brought out in this article as he would, for example, to the *law of definite weight*, or the *percentage composition* of a substance. *Valence is only a theory;* structural symbols are pictured explanations, on the atomic theory, of results obtained by analysis—nothing more. They prove nothing—they simply illustrate.

It is suggested that the reader obtain a set of wooden blocks about 2 inches square and fasten eye-screws therein, for the more important elements and then try and arrange them to illustrate graphic formulæ of various compounds as shown in the accompanying photograph (Fig. 1). Fig. 2 shows a method of affixing the eye-screws to a few of the elements.

Different indices have been employed to represent valences as I II III IV V (never 1, 2, 3, 4, 5). These should be placed at the right ofthe atom symbol, as shown in the above examples.

Atoms are often pictured as having hooks, or bonds to attach them to other atoms. *Mounds* have *one* hook each, *dyads* have *two* hooks or bonds, *triads three, tetrads, four, etc.*

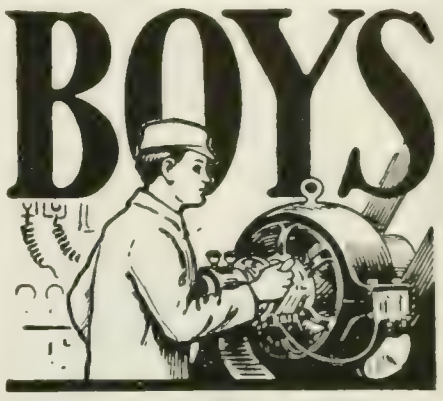
MODERN PHYSICS AND THE ELECTRON.

(*Continued from page* 603)

out of these same units, then the total speed which the field will impart must be an exact multiple of the change in speed which the capture of an ion produces. In other words, if electricity is atomic in structure, you cannot get in a given field anything except a definite number of speeds, which will make an arithmetical series, that is, will come up by steps, one, two, three, etc.

That is exactly what we found. We have experimented with thousands of drops and scores of different substances, and they always work exactly that way. Both positively and negatively charged drops are found to act in quite the same way, showing that both positive and negative electrical charges are built up of specks of electricity. Further we can count the number of those specks, which we will call *electrons*, in a given drop, with the same certainty with which you can count the number of fingers that are before you now. And again since Rowland showed that an electrical current

$2.50 a Month
The masterpiece of watch manufacture—adjusted to the second, positions, temperature and isochronism. Encased at factory into your choice of the exquisite new watch cases.
21 Jewel
Burlington
All sizes for both men and women
The great Burlington Watch sent on simple request. Pay at rate of $2.50 a month. You get the watch at the same price even the wholesale jeweler must pay.
Write Today for Free Watch Book
See handsome color illustrations of all the newest designs in watches that you have to choose from. Your name and address on a postcard is enough. Get this offer while it lasts. Write today.
Burlington Watch Co. Dept. 7441 19th & Marshall Blvd. Chicago



Big Money in Electricity

The electrical industries offer wonderful opportunities to boys with a liking for Electricity. The salaries paid to trained men are large, promotion comes rapidly and, best of all, the work is fascinating.

The discovery and development of new lines (such as wireless telegraphy and telephony), from time to time, promise attractive and paying fields to those who wish to specialize. The *will to do* and *Special Training* will bring success to *you.*

The International Correspondence Schools can help you to become an expert in electrical work, no matter what branch you like best. Thousands of young men have already won success through I. C. S. help. You can do as well as anybody, *if you try.* Everything is made so clear that you can learn in your spare time, regardless of where you live or what your work. No books to buy.

There's big money in Electricity. Get after it by marking and mailing the Coupon today. *Finding out costs you nothing.*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 5367, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BOOKKEEPER
MECHANICAL ENGINEER	Stenographer and Typist
Mechanical Draftsman	Cert. Pub. Accountant
Machine Shop Practice	Railway Accountant
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	Common School Subjects
MINE FOREMAN OR ENG'R	CIVIL SERVICE
Metallurgist or Prospector	Railway Mail Clerk
STATIONARY ENGINEER	Textile Overseer or Supt.
ARCHITECT	AGRICULTURE — Spanish
Architectural Draftsman	Navigator — German
PLUMBING AND HEATING	Poultry Raising — French
Sheet Metal Worker	Automobiles — Italian

Name _____

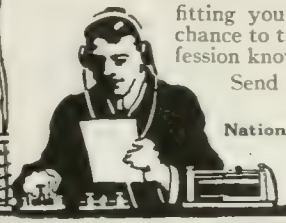
Present Occupation _____

Street and No. _____

City _____ State _____

Wireless Taught By Mail

You May Learn Theory, Code and Laws of Radio Communication in Our School or at Your Home



fitting you for positions paying good salaries with wonderful chance to travel the world over. It's the most interesting profession known and the demand for skilled operators is increasing.

Send stamp for catalog giving facts.

RESIDENT CLASSES ENTIRE YEAR

National Radio School, 14th & U Sts., N. W., Washington, D. C.

NAVY NEEDS OPERATORS

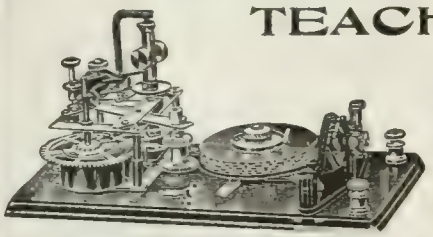
15,000 NEEDED FOR THE ARMY

"THERE'S MONEY IN IT"

AT HOME **LEARN TELEGRAPHY** AT HOME

MORSE AND WIRELESS

TEACH YOURSELF



in half the usual time, at trifling cost, with the wonderful Automatic Transmitter, **THE OMNIGRAPH.** Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.

39L Cortlandt St. New York

The House of Taylor

IN THE HEART OF THINGS

400 Baths
600 Rooms

HOTEL MARTINIQUE

BROADWAY, 32D STREET, NEW YORK

One Block from Pennsylvania Station.

Equally Convenient for Amusements, Shopping or Business.

157 Pleasant Rooms, with Private Bath, $2.50 PER DAY.

257 Excellent Rooms, with Private Bath, facing street, southern exposure, $3.00 PER DAY.

Also Attractive Rooms from $1.50.

The Restaurant Prices Are Most Moderate.

Sterling Electric Heating Pad

This exceptional pad helps make the electrical home—safe, reliable, always ready.

It is a welcome successor to that disagreeable nuisance, the old, heavy, clumsy, hot water bag which needs constant refilling, may burn or discharge scalding water and which "cools off" just as comfort comes.

The Sterling pad wins quick friends by its good work in all ailing conditions benefited by the continuous application of heat, such as sprains, toothache, cramps, chills, grippe, pneumonia, insomnia, inflammation, backache, neuralgia, rheumatism, poor circulation, and muscular afflictions from foot to head and from babyhood to old age.

It may be used anywhere at any time in the home, hotel or hospital.

This Sterling pad is safe, cannot overheat and is made doubly dangerproof by two most clever automatic thermostats independent of the heating control. You can pay more but you cannot buy more in a Heating pad. Fully guaranteed.

Free Literature and Special Introductory Offer.

Agents Wanted in All Open Territory.

THE STERLING ELECTRICAL CORPORATION, Church Avenue, Cor. West 28th Street, Cleveland, Ohio, U. S. A
Branches in all parts of the world.

TYPEWRITER SENSATION

$2.50 a Month Buys a Visible Writing L. C. Smith

Perfect machines only of standard size with keyboard of standard universal arrangement—has Backspacer—Tabulator—two color ribbon—Ball Bearing construction—every operating convenience. **Five Days' Free Trial.** Fully guaranteed. Catalog and special price sent free.

H. A. SMITH, 738-231 North Fifth Avenue, CHICAGO, ILLINOIS

STORAGE Marko BATTERY

The Mark O'Quality

Marko Storage Batteries

for **all purposes where a high grade storage battery is required**

PAUL M. MARKO & CO. { 1191 Bedford Ave., Brooklyn / N. Y. Depot, 974 8th Ave., N. Y. City

is nothing but a charge in motion, you have here the proof that the electrical current that goes thru these lamps, for example, is nothing except the motion of a certain number of electrical specks thru or over the filament of the lamp. Add to that J. J. Thomson's discovery made in 1881, that an electrical charge possesses inertia, the only distinguishing property of matter, and you have made it perfectly legitimate to say that an electrical current in a wire is *a definite material, granular something which is moving along that wire.*

This brings me to the next of our discoveries namely *the discovery of the nucleus atom.* Let me give you just a brief statement of how we know that the atom is somewhat like a miniature solar system, with an extraordinarily minute nucleus, the size of the nucleus never being more than 1/100,000 part of the diameter of the atom, with a certain number of subsidiary bodies—negative electrons—which we should liken to the planets, somewhere around the outside. How do we know that is the case? We have this direct evidence. Nature takes a helium atom which is going with a speed of 18,000 miles per second, and nature shoots that atom right thru a glass wall without leaving any hole behind, and without in any way interfering with the structure of the molecules of the glass. I can show you photographs (see Figs. 3 and 4) that make the thing so clear that the wayfaring man can see it, you don't need to be a physicist.

This obviously means that the positive nucleus itself must be extraordinarily minute. Indeed the fact that the negative electron actually shoots thru those hundreds of thousands of atoms without ever going near enough to any constituent of those atoms to knock any one of them out, and the fact that the positive nucleus of helium, viz; the alpha particle, shoots thru even more molecules without being deflected at all from its course, causes one to wonder whether there was anything at all that is impenetrable in the atom. Why do we say there is a nucleus there? Because direct experiment says there is. There is a certain portion of the atom which the alpha particle itself cannot penetrate. If the impact is head on, the alpha particle goes right up to the atom and then it backs straight back again, or if it comes up to the atom at an angle like this it goes off that way. (Illustrating.) It is only rarely that that happens, but Rutherford and Geiger and Marsden counted the percentage of alpha particles which goes straight on and the percentage which goes off here, and in that manner, by perfectly simple algebraic analysis that any one of you can understand, without any assumption at all except the law of inverse squares, which can hardly be called an assumption, at least so far as the attraction between the *positive* nucleus and the *negative* electron is concerned we find how big that nucleus is. By the size of the nucleus I mean the size of that portion of the atom which is impenetrable to the alpha particles. It comes out something like 10^{-12} centimeters. The diameter of the atom is 10^{-8}. Furthermore, by counting how the deflections of the alpha particles are distributed around this sphere, which we can do directly with the aid of zinc sulfid spread over the inside of the sphere we can obtain the number of alpha particles deflected thru any given angle, and then with a little analysis of unquestionable correctness, we find how many unit charges, positive electrons, there are in this exceedingly small nucleus, and it comes out approximately one-half of the atomic weight.

Now, I come to another extraordinary discovery which did not merely tell us

approximately how many electrons there are in the nucleus but it told us *exactly* how many there are, and the result checked too with the number obtained by the foregoing approximate method. This brings me to the recent discoveries in the field of X-rays, and I will call the seventh of the modern advances the discovery of the nature of X-rays, which was virtually made by Barkla in 1904. For Barkla and others had proved that there are two types of X-rays, first, X-rays which consist in simple ether pulses pushed off from an electron when it changes its speed; and second so-called characteristic X-rays which are formed thus. When the electrons bump into a target they set something in the target into vibration, and this something sends off perfectly definite characteristic X-rays, which are like monochromatic light. So, we have two types of X-rays, pulse X-rays, like white light, and monochromatic X-rays, like monochromatic light, such as mercury gives rise to. That is the seventh of our great modern discoveries and it must be credited chiefly to Barkla.

FOG WARNING BY RADIOPHONE.

(*Continued from page* 591)

described in Dr. de Forest's patent. The transmitting apparatus is so arranged that speech can be sent out from the large fog horns as also musical notes, bell signals, et cetera; on the same prearranged schedule as the radio signals. In this scheme the phonograph with records containing speech is coupled to a microphonic arrangement and the speech is intensified by means of amplifiers and the sound waves sent out thru the fog horns, thereby enabling the captain or other officer to hear the same without the aid of wireless apparatus.

The one big feature of the Point Judith Light equipment is that when a ship is within a range of eight miles of the lighthouse, it will hear the following words flashed by wireless every five seconds—*"Point Judith Light"*; and after every third repetition the warning—*"You are getting closer; keep off,"* is sent out with a limit of range of about two miles. These signals will be sent out during fog, mist, rain, and falling snow.

When sent out by radio the signals can be heard with any suitable or well-known wireless telegraphic, or wireless telephonic receiving apparatus which may be employed to receive, detect, or reproduce the emitted or radiated signals. Crystal detectors may be used. The signals are sent out on a wave length continuously varied between 550 and 650 meters.

If the apparatus is equipt for musical note signals these will be received by a ship at sea; for instance, suppose the ship receives the note corresponding to middle "C"; then it will be known that the lighthouse is four miles away.

If both the middle "C" and the "E" notes are heard, then it will be known that the distance between the ship and lighthouse is only three miles. If the middle "C," "E" and "G," are detected at the receiving station, the distance is two miles, and if all four notes are heard then the distance away is one mile or less, and so on for any other pre-arrangement and adjustment of the apparatus.

This invention is bound to be a great help to all mariners and the system is a direct innovation over any that have heretofore been tried. Doubtless many disasters and wrecks will be avoided and in general to make navigation safer, altho probably it will not have as good a chance to demonstrate its great possibilities till after the war is over.

Every important lighthouse and light ship on the U. S. coasts will be fitted with this new Radiophone fog signal, as conditions permit the work to be carried on.

HOW AURORA BOREALIS AFFECTS TELEGRAPH AND CABLE LINES.

(*Continued from page* 593)

appear to be due to abnormal *earth currents* induced in our globe, and which currents cutting across such lines, induce in them powerful transient currents of short duration.

On October 31, 1903, aurora borealis disturbances affected telegraph and telephone lines extending between Chicago and the eastern cities. On telegraph wires, without regular battery being applied at terminal offices, grounded lines showed a potential of 425 volts positive, varying to 225 volts negative; the disturbance continuing between 12:15 a. m., and 9:15 a. m.

Measurements were made with ordinary direct current voltmeters. The voltage readings were not constant or steady. The positive indication, for instance, would, during a period of 3 or 4 minutes, swing backward and forward in degrees between 200 and 425 volts. Once, however, the needle of the reversely connected voltmeter indicated negative potential; the potential increased rapidly up to 225 volts; varying then, between 100 and 225 volts negative.

The ohmic resistance of the lines was about 2,000 ohms; grounded at Chicago and Pittsburgh, Pa., and at Chicago and Buffalo, N. Y. This and the following report are presented thru the courtesy of Mr. Donald McNicol, assistant electrical engineer, Postal Telegraph Cable Company, who has given this subject much study.

With reference to earth currents and cables, the writer (Mr. McNicol) may be permitted to quote extracts from his official report of 1892, in connection with the trans-Atlantic determination of longitude. At that time there were ten cables across the Atlantic, but when earth currents set in they are not all equally disturbed; in fact, it happens that some of the cables are not affected at all. The French cable from Brest, France, to St. Pierre, Miquelon Island, (near New Foundland), seems to be disturbed the most, and again the disturbances are felt to a greater extent at St. Pierre than at Brest. It often happens that St. Pierre can send messages to Brest, but cannot receive any.

Long cables seem to be more affected than short ones, and, furthermore, the abnormal earth currents appear to travel mostly from *east to west.* When the aurora is visible, it is quite certain that earth currents will show themselves. Thunderstorms and they, however, do not seem to be so closely related, if, at all.

During the past season (1892), on July 16th, there was a remarkable disturbance noticed at Canso, Nova Scotia, stopping all work completely. The greatest "kick," as it is called, was given at 12:20 p. m., eastern standard time, or 5:20, Greenwich mean time. Some weeks afterwards reports came in the technical journals, from Brest, Malta, Cairo, Madras and east to Singapore of a similar disturbance on that day. Cairo, Egypt, fortunately stated the time, and from it, it was found to have been simultaneous with that of Canso.

On August 24 (1892), strong earth currents set in at Canso, and at the time there was a marked auroral display. The southern cable (Commercial Cable Company) was far more affected than the northern one. As most of the companies have two cables, they can generally get rid of the effects of earth currents by looping the

FREE
$20.00 VIOLIN
Ukulele Guitar, Mandolin, Hawaiian Guitar or Cornet

Yes, absolutely free to first pupils in each locality. We have the most wonderful, new system for learning by mail to play by note. Piano, Organ, Violin, Mandolin, Guitar, Ukulele, Hawaiian Guitar or Cornet. Very small charge for lessons only expense. We guarantee success or no charge. Complete outfit free. Write now. No obligations.
Slingerland School of Music, Dept. 238, Chicago, Ill.

414 PAGES
145 ILLUSTRATIONS

I.C.S. ELECTRICAL ENGINEER'S HANDBOOK
50¢

ELECTRICITY!

HERE'S just the book on Electricity that you need to answer your many questions—to solve your knotty problems, to teach you new kinks, to be your memory for tables, rules, formulas and other Electrical and Mechanical facts that some people try to carry in their heads—and fail.

With this "Little Giant" I. C. S. Electrical Engineer's Handbook in your pocket, tool chest, on your work bench, drawing table or desk, an hour or a day need not be lost "digging up" some forgotten rule, some unfamiliar fact; you'll just turn to the very complete index and get it "in a jiffy." Just a few of the subjects treated are:

Electricity and Magnetism; Electrical Symbols; Batteries; Circuits; Magnets; Direct and Alternating Currents; Dynamos and Motors; Belts; Shafting; Electroplating; Electrical Measurements; Meters; Arc and Incandescent Lamps; Mercury Arc Rectifiers; Transformers; Insulation; Electric Cars; Single and Multiple-Unit Control; Transmission; Rail Welding; Tables of Wires—Sizes, Capacities, etc.,—Mathematical Rules, Formulas, Symbols; Tables of Constants, Equivalents, Roots, Powers, Reciprocals, Areas, Weights and Measures; Chemistry; Properties of Metals; Principles of Mechanics; First Aid, etc.

The Electrical Engineer's Handbook is one of 22 I. C. S. Handbooks covering 22 Technical, Scientific and Commercial subjects, all crowded with value. They have the contents of a full sized book condensed into pocket-size ready to go with you anywhere and be at your instant command. They are substantially bound in cloth, red edges, goldleaf stamping, printed from new, clear, readable type on good quality book paper. There is an illustration at every point where a picture will help. Hundreds of thousands have been sold on a money-back guarantee of satisfaction.

The former price of these Handbooks was **$1.25**, but

THIS MONTH you can buy the ones you want for only 50c each, postpaid

(For 10c extra we will send a cloth-covered protecting case.)

You Run No Risk! Money Back if Desired!

International Correspondence Schools
Box 5368, Scranton, Pa

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 5368, SCRANTON, PA.

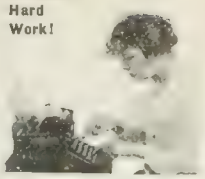
I enclose $ for which send me postpaid the Handbooks marked X, at 50c. each. I may return any or all and get my money back within ten days from receipt.

☐ Electrical Engineer's	☐ Advertiser's
☐ Telephone and Telegraph Engineer's	☐ Business Man's ★
☐ Mechanic's	☐ Bookkeeper's
☐ Steam Engineer's	☐ Stenographer and Correspondent's
☐ Westinghouse Air Brake	☐ Salesman's
☐ Civil Engineer's	☐ Window Trimmer's
☐ Coal Miner's	☐ Cotton Textile Worker's
☐ Concrete Engineer's	☐ Farmer's
☐ Building Trades	☐ Poultryman's
☐ Plumber's and Fitter's	☐ Mariner's
☐ Chemist's	☐ Automobiles

Name
Street and No.
City State

80 to 100 Words a Minute Blindfolded!

30 Words a Minute—Hard Work!



The New Way

Speed of 80 to 100 words a minute guaranteed. Absolute accuracy. Amazing ease in typewriting. Has increased salaries from $8, $10 and $15 a week to $25, $35 and even $40 a week.

The Old Way

Speed of 30 to 40 words a minute. Frequent errors. Hard work. Keeps stenographers' salaries down to $8, $10 and $15 a week. Anyone can quickly change from the Old Way to the New Way in 10 Easy Lessons.

Typewrite The New Way

Employers pay for the amount and quality of FINISHED WORK you turn out. Double or treble your typewriting efficiency and your salary will increase in proportion.

The NEW WAY is a revolutionary new method of saving work and time and eliminating errors in typewriting. 80 to 100 words a minute GUARANTEED. Already thousands of stenographers have so vastly INCREASED THEIR VALUE, through the New Way, that their salaries have been increased to $25, $35 and even $40 a week.

LEARN IT AT HOME; 10 EASY LESSONS

Yes--only ten easy lessons and this wonderful speed and accuracy in typewriting are YOURS. No interference with your present work. Learn at home, largely away from the machine. Not like the old "touch" system. Hundreds of "touch" typewriters have doubled and trebled their speed through the New Way. Based on GYMNASTIC Finger Training--an entirely new idea. Entire course on trial; no cost to you unless it brings the desired results. Write postal to-day for full particulars. Read why the small cost of the Course will quickly come back to you many times over. Address

The Tulloss School, 3541 College Hill, Springfield, Ohio

Experimenter's Special Bench Lathe

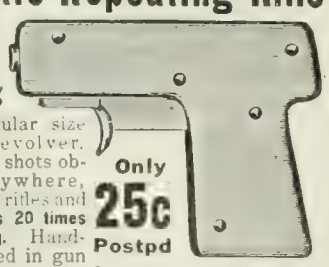
A Regular Lathe, not a toy

EXPERIMENTERS: This is the first practical lathe especially designed for all kinds of experimental work. With this lathe you can make almost anything described in this magazine, whether it is in the "Constructor" Department or "How-to-Make-It" Department. Particular attention is called to the fact that cardboard tubes can be wound nicely with wire by means of this lathe, and it can easily be driven by means of a sewing machine or by a small electric motor.

Excellent for small wood turning, fibre turning, etc. Lathe is made from finest materials. Size sixteen inches over all—swing 4 inches. 11 inches center to center. Bed is machined and centers accurately; shipping weight is 13 lbs.; price $4.00 cash with order.

Sypher Manufacturing Co.
Department C, Toledo, Ohio

Automatic Repeating Rifle



Fires 20 Shots in One Loading

Only **25c** Postpd

This is a regular size automatic revolver. Shoots B. B. shots obtainable anywhere, same as other rifles and guns. **Repeats 20 times with one loading.** Handsomely finished in gun metal. No caps or load necessary, as it works with a spring and shoots with rapidity and accuracy. Simply load with 20 B. B. shot, then press the trigger. Nothing to explode — absolutely harmless and safe. Remember, it is not a mere toy, but the same size and shape as a REGULAR AUTOMATIC. Sent complete with a round of shot for ONLY 25c postpaid.

JOHNSON SMITH & CO., Dept. 923, 54 W. Lake St., Chicago

Auto Battery Charging Pays Big Profits Users of 500 Watt HB Chargers clearing $20 to $60 a month extra profit. $15 puts this money-maker in your garage. Balance in eight monthly payments of $20. Money-back guarantee. Mail this ad with name for full particulars **Hobart Bros.Co., Box 1E,Troy,Ohio**

cables together, that is, by making a metallic circuit. Sometimes the earth currents are so strong as to injure the condensers.

From the direction of the cable it is noticed that cables running east and west are more troubled with these currents than cables running north and south. There is, however, a wide difference on east and west lines. The superintendent at St. Pierre told me that he had experienced more earth currents in the past two years (1891, 1892) at that place, than in the preceding eighteen years at Torbay and Canso, N. S., and besides that they were felt more on the American than on the European side.

And furthermore: "The cable is quite unprejudiced and shows equal favor to positive or negative gallantries. They are of the most erratic nature; sometimes they take off their things and make quite a visit, one, two or three days, varying greatly in their demonstrativeness during the time, but seldom getting so bad as to totally stop traffic. Sometimes they favor us with a two or three-minute call only, as if to remind us that they are still alive. They fluctuate in degree very greatly. The strength of electromotive force of these earth currents has run up to 500 volts."

GROUND TELEGRAPHY IN WAR.

(*Continued from page* 592)

the system will operate. The writer in 1903 by a system of this type was able to telephone over a distance of three miles, using an arrangement of buried plates whereby a zinc plate was buried in the ground, while a copper plate was buried three or four times the depth of the zinc plate. The plates in this case having the same function as the spikes described above.*

In the French system mentioned, the transmission of the intelligence is accomplished by means of a low power high frequency buzzer of a certain periodicity, and the signals are received at the other end by specially attuned wireless telegraph receiving apparatus, making use of a detector, tuning inductances, etc.

There are several reasons for this. In the first place if a very powerful buzzer were used in the front trenches, it will be understood that while the signals would be received in the rear without much trouble, using highly sensitive wireless receiving apparatus, the enemy as well would have but little trouble in receiving the same messages thru "No Man's Land."

While such messages could be sent in code, nevertheless, as has been pointed out frequently by us, codes are of very little use in this war, for given time, the enemy will decipher any code no matter how ingeniously contrived within a few hours. For that reason, even today at all fronts, codes are changed almost with every other message. It is merely the time element that is required to get the message thru, and even if the enemy does decipher the message, it will take him a few hours. His purpose will be defeated, however, as the order will probably have been executed long before the enemy found time to decipher the message.

Just the same, the French have taken precautions to see that whatever messages they do send by means of their new ground telegraph, these shall not fall into the hands of the enemy. And they have actually accomplished this. We are not permitted to state just exactly how this result is achieved, except that we may state that the spikes or plates of the sending outfit are

* See "Wireless Telephone" by H. Gernsback, Page 26.

SEND PICTURES BY ELECTRICITY

Latest sensation in electrical advancement, affords wonderful entertainment. You can send pictures of your friends by electricity over telegraph wires or by wireless. The picture and the signature in this advertisement were sent and received by this system. A marvel for experimental purposes, furnishing instruction in the coming science. See big article Dec. issue of this magazine on pages 516-517, explaining system in full.

MARVEL OF TODAY
NECESSITY OF TOMORROW

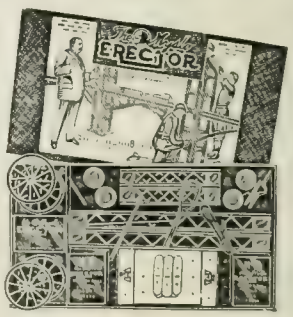
Electrical experts and scientists have declared the Leishman Electrical Picture Transmission System is the marvel of the age. Excites amazement wherever used and has already entertained thousands of people. This company has arranged for special model sizes of the Leishman System, which can be secured now.

Price Only $15

Manufacturers

L. J. LEISHMAN CO.
Dept. M, **Ogden, Utah**

"ERECTOR" BUILDING OUTFITS



The Erector Set No. 2
contains 205 parts and makes 120 models

No. 8501 "Erector" No. 1 Building Outfit, consisting of 140 parts, will build 69 models and more, all packed in neat compartment box..... $1.00

Shipping weight 3 lbs.

No. 8503 "Erector" No. 3 Building Outfit, consisting of 345 parts, will build 176 models and more, all packed in neat compartment box..... $3.00

Shipping weight 6 lbs.

No. 8506 "Erector" No. 6 Building Outfit, consisting of 1,000 parts, including new model Electrical Motor. This most elaborate Outfit will build 264 Models, even Railway Stations, Battleships, Aeroplanes and so forth $10.00

Shipping weight 16 lbs.

THE ELECTRO IMPORTING CO.
231 Fulton Street New York

Print Your Own Cards, circulars, label, book, paper. $6. PRESS. Larger $20. Rotary $50. Save money. Print for others, big profit. All easy, rules sent. Write factory for catalog presses, TYPE, paper, cards. **THE PRESS CO., D-47 Meriden, Conn.**

Learn Watchwork, Jewelrywork and Engraving. A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog

"screened" in such a way that the resulting excitation only goes towards one direction, and does not reach the enemy at all. Then too, the high frequency buzzer is of such low power and is attuned in such a manner, that it is almost impossible to receive the signals unless they are tuned to the exact wave length, which wave length is changed every hour by both sending and receiving operators.

The advantage of this system is that it can be put in operation within a few minutes in any first-line trench and it has been so perfected now that it can be used even in advance outposts in "No Man's Land" where it would be practically impossible under normal conditions to run a line wire to the rear due to difficulties encountered in the terrain.

Nor is it necessary to separate the spikes or plates any great distance. We understand that from ten to fifteen feet is all that is required in practise, and what is most important of all, a complete outfit such as described here does not weigh more than about ten pounds, and therefore, does not take up much room. It also can be taken down very quickly in case of emergency. The other advantage is that positive communication is had at all times with the rear, and that no matter what happens to the communication trenches, the rear and the front trenches can still communicate with each other. It is of course self-understood that by means of a double-pole switch, the front line trench can send as well as receive messages. In other words, this system works exactly as an ordinary wireless outfit.

BRONZE TABLET TO MARK FIRST EDISON STATION IN NEW YORK.

(*Continued from page* 598)

marked the real entrance of the Pearl Street station into the supply of electric power to New York and its people.

This tablet marks the location of the First Edison Central Station for electric light and power establisht in America, but it wasn't the first Edison Central Station started in the world; that honor belongs to the Holborn Viaduct Central Station establisht in London, England, nearly eight months before, *i. e.*, Jan. 12, 1882, which started with two "Jumbo" dynamos and 938 lamps, which load was soon increased to 3,000-16 C.P. lamps, a third Edison "Jumbo" being added shortly thereafter. This plant was erected by Mr. Edward H. Johnson, Mr. Edison's representative in England at the time, and Mr. William J. Hammer, the chief engineer of the English Edison Company, who personally closed the switch starting up this the world's first central station for incandescent electric lighting.

The "Jumbo" dynamo is world famous, altho there are few people who know where the name originated, and we are indebted to Mr. Hammer for our enlightenment on this point. Mr. Hammer says that in 1881, Mr. P. T. Barnum, the famous showman, purchased for his circus the world's greatest elephant—"Jumbo"—from the London Zoölogical Gardens, and Jumbo was shipt to New York on the S.S. *"Assyrian Monarch,"* and upon the return of this steamer to England it carried as part of its cargo the two 30-ton Edison dynamos known as Nos. 2 and 3 (No. 1 having been sent to the Paris Electrical Exposition of 1881), and it occurred to Mr. Hammer upon installing these two huge machines to call one of them "Jumbo," the other "Alice" (after "Jumbo's" mate), and this term "Jumbo" has ever since stuck to this remarkable type of Edison dynamo, which was the true wonder of its day.

Many extremely interesting incidents occurred in the operation of this pioneer central station on Pearl Street. For instance, it was found very difficult to regulate the dynamos and engines as to speed and voltage and one of the expedients invented to improve this regulation was to have the attendants slip a small weight on or off the engine governor. Note the massive feeder switches on the wall of this early electric light station which look like giant nut-crackers. These switches were fitted with a strong spring which tended to open the blade and which was released from contact by a special trip. The switch thus opened quickly and with a minimum of sparking.

And commutator troubles. Oh! yes, they had them a-plenty in those epochal days. Due to the severe vibration set up by the high-speed 30-ton Jumbo dynamos and their attached engines, the brushes would chatter like a monkey. One of the cures proposed for this malady involved the application of a mercurial paste to the commutator, in order to improve the conductivity between the commutator and the brushes. The mercury tended to slightly short-circuit the commutator bars and last but not least, the faithful dynamo attendants were attacked by the mercury fumes liberated, their teeth being the first point of attack. Then again it finally became necessary to actually "gold plate" the commutator connections, as these joints, being formed of copper bars, tended to work loose at high speed and oxydize. As soon as the oxydization set in, the circuit thru that particular joint would begin to fail and to obviate this trouble the surfaces were "gold plated" as aforementioned.

In 1903 the Waterside Station Number 1, complete with sixteen vertical engines of 5200-5500 horsepower each, sent out electrical energy to various distributing centers. But even this was not enough for the growing city and for industry which under the spur of electric power was being re-made and thereby re-making New York. So Waterside Number 2 was built in 1906, beside Waterside Number 1 at First Avenue and Fortieth Street.

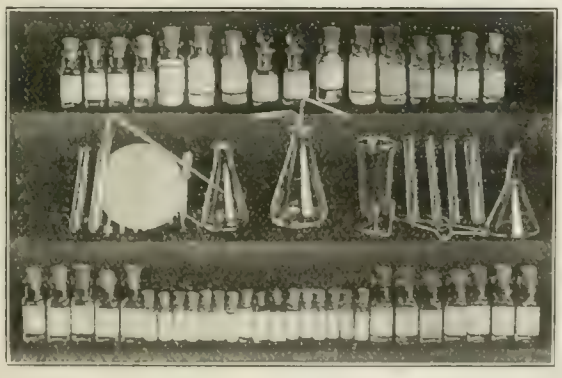
In both stations today, in contrast with 900 horsepower in generators in the historic Pearl Street station, are generators of nearly 500,000 horsepower, among them great units of 45,000 horsepower each, with still larger ones planned. And from these electric current goes to thousands of customers thru miles of mains covering all Manhattan and the Bronx.

One of the views herewith shows a modern electric dynamo which is not so much larger than the 150 horsepower "Jumbo," but which when fully excited can produce 50,000 kilowatts or more than 67,000 horsepower, or about 450 times as much electrical energy as its predecessor.

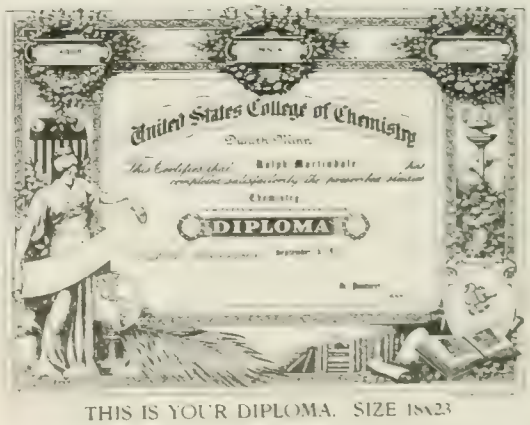
What an Investment of $5.00 will bring you

A $2,500 Genuine College Course in Chemistry, Absolutely Free

Become a College Graduate and Win Success, Position and Wealth



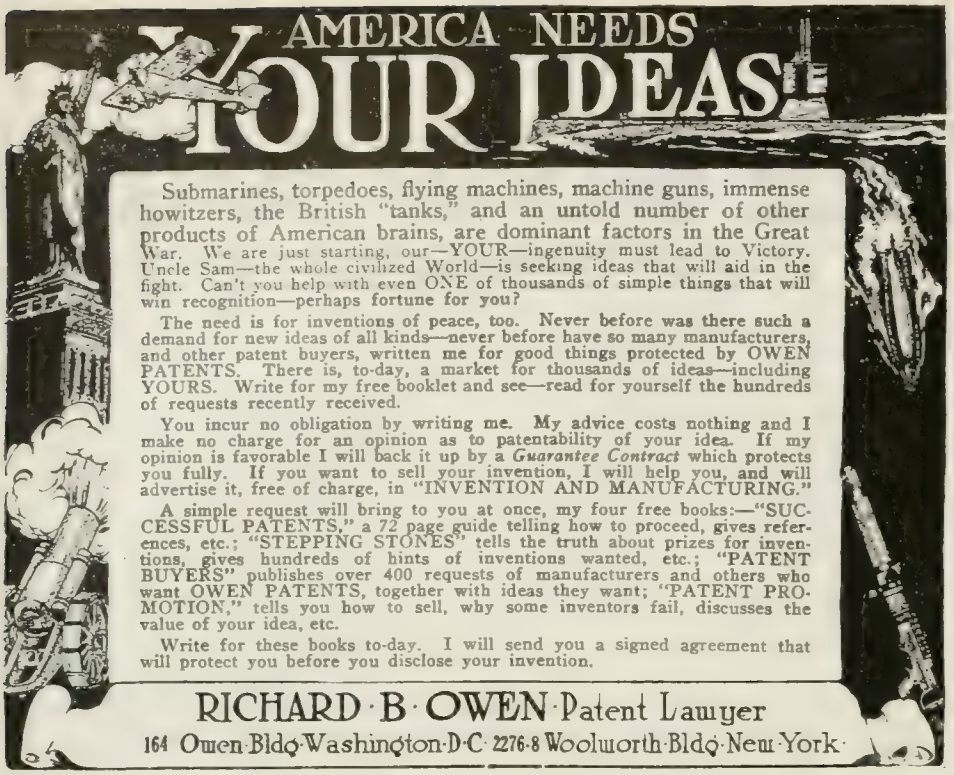
YOUR $5.00 LABORATORY IS WAITING



THIS IS YOUR DIPLOMA. SIZE 18X23

Are You Earnest, Energetic? Are You Satisfied With Your Present Position in Life? Do You Want To Become a Successful Man? Then Send In Your Order TO-DAY, or Send Three Cents in Stamps for Catalogue and Information.

ZENITH CHEMICAL LABORATORIES :: DULUTH, MINN.



Submarines, torpedoes, flying machines, machine guns, immense howitzers, the British "tanks," and an untold number of other products of American brains, are dominant factors in the Great War. We are just starting, our—YOUR—ingenuity must lead to Victory. Uncle Sam—the whole civilized World—is seeking ideas that will aid in the fight. Can't you help with even ONE of thousands of simple things that will win recognition—perhaps fortune for you?

The need is for inventions of peace, too. Never before was there such a demand for new ideas of all kinds—never before have so many manufacturers, and other patent buyers, written me for good things protected by OWEN PATENTS. There is, to-day, a market for thousands of ideas—including YOURS. Write for my free booklet and see—read for yourself the hundreds of requests recently received.

You incur no obligation by writing me. My advice costs nothing and I make no charge for an opinion as to patentability of your idea. If my opinion is favorable I will back it up by a *Guarantee Contract* which protects you fully. If you want to sell your invention, I will help you, and will advertise it, free of charge, in "INVENTION AND MANUFACTURING."

A simple request will bring to you at once, my four free books:—"SUCCESSFUL PATENTS," a 72 page guide telling how to proceed, gives references, etc.; "STEPPING STONES" tells the truth about prizes for inventions, gives hundreds of hints of inventions wanted, etc.; "PATENT BUYERS" publishes over 400 requests of manufacturers and others who want OWEN PATENTS, together with ideas they want; "PATENT PROMOTION," tells you how to sell, why some inventors fail, discusses the value of your idea, etc.

Write for these books to-day. I will send you a signed agreement that will protect you before you disclose your invention.

RICHARD B. OWEN Patent Lawyer
164 Owen Bldg. Washington D.C. 2276-8 Woolworth Bldg. New York

Patent Secured or Fee Returned Hundreds of inventions sold yearly. We help market yours without cost. Our new book is Free. Send model or sketch for free opinion.

A. M. BUCK & CO.
205 2nd National Bank Bldg., Washington, D. C

Electricians Get up-to-date in HOUSE WIRING! Save TIME, MONEY, LABOR and MATERIAL by using our 58 GENUINE BLUE PRINT DRAWINGS, containing all the latest diagrams and connections known in house wiring—every diagram and connection up-to-the-minute as used by first-class electricians for wiring BELLS, BURGLAR ALARMS, LIGHTS, ANNUNCIATORS, FIRE ALARMS and ELECTRIC GAS LIGHTING. These drawings are bound in the form of a flexible book 9 x 12 for convenience in using on the job. Send for them, and if they don't make you more efficient as a wireman and save you many times their cost as a contractor, return them and money will be refunded—you can't afford to be without them. ONE DOLLAR post paid. Send for circulars on other sets of drawings.

PATENT SPECIALTY COMPANY
462 Sanchez Street San Francisco, Cal.

U.S. PATENTS

PATENTS TRADE MARKS
LANCASTER & ALLWINE
REGISTERED ATTORNEYS

FREE BOOK & FORM EVERY INVENTOR SHOULD USE

LANCASTER & ALLWINE
WASHINGTON, D. C.

Toy Inventions Wanted

More than $25,000,000 worth of toys are used annually in the United States. Some of the most simple toys have netted fortunes to the inventors. We have requests from many of the largest toy makers in the United States for patents on toys and novelties obtained through us. Work up some toy or game that is amusing, educational, that promotes health by exercise or stimulates interest in engineering, chemistry, electricity, and submit it to us for our free opinion and report. If it is new and patentable we will aid you in obtaining protection on it and in closing negotiations with manufacturers.

For instance, on June 10, 1916, we filed an application for patent on a sand operated toy shown below, invented by our client, Mr. B. B. Bliss, of Holt, Mich., and on June 21, 1916, put him in touch with the largest toy manufacturers in the U. S. On December 26, 1916, the patent was allowed and before the patent issued we had closed negotiations for Mr. Bliss, selling the invention to the largest sand toy manufacturer in the U. S.

No matter what your invention may be our cooperation is, First, to help you establish your rights before sending a sketch, drawing or model to any attorney; Second, to give a frank opinion whether it will pay to patent your idea, based upon our extensive knowledge of the patent laws, manufacturers' wants and facilities; Third, to obtain for you on reasonable terms, a patent that absolutely protects; and, Fourth, advise and assist you in making the invention a source of profit by outright sale, territorial grants, obtaining royalty, or the independent manufacture of the invention.

Send drawing or model for opinion. You can get our book on patents, form "Evidence of Conception" and bulletins of inventions wanted, free of charge, by asking for them on a post card or simply mail coupon below.

COUPON

LANCASTER & ALLWINE, 287 Ouray Bldg., Washington, D. C.

Send me free book, "Inventions-Patenting and Promoting," special bulletins of Inventions Wanted, and blank form "Evidence of Conception."

Name .....

Address .....

WAR ADDRESS BY A. I. E. E., PRESIDENT-ELECT E. W. RICE, JR.

(*Continued from page* 609)

With the destruction many laps ahead, it is vitally important that ships should be loaded and unloaded with the utmost expedition. We have recently heard of an instance where a large ship, after running the gauntlet of a voyage to England, was forced to visit several different ports, and waste one month's time, before starting the return voyage. This loss of time is equal to the loss of a complete voyage. The net tonnage delivered per month is the only thing that counts, therefore ship-tons saved are worth more than ship-tons built. Quick methods of loading and unloading at specially devised terminals, here and in Europe, should be developed and put into operation. The methods are known. It simply remains for us to organize and apply them.

We must see to it that the kind of ships, in respect to size, material and speeds, are such that the greatest tonnage may be moved across the seas in the shortest time. In the time element must of course be considered the time required to build such tonnage. If an investigation should indicate that cargo ships can be built which will successfully *withstand* one or more torpedo attacks, and which can also be provided with speed and armament sufficient to give them a good chance of fighting off and getting away from a submarine, they should be built no matter whether such ships cost more, or are less adapted for use after the war, or take a little longer time to construct than those of the ordinary type.

It is entirely within the range of possibility that such ships may prove to be the only ones which will be able to navigate the seas with any decent chance of surviving. It would seem clear that, unless the submarine is swept from the seas, it is hopeless to build a large tonnage of slow moving, relatively small and inadequately defended ships, as the net tonnage which could be delivered by such a fleet of ships will be too insignificant to be of any material value. We would have bet on the wrong horse and lost; therefore, I hope that we will have the foresight to build as large a number as possible of big, comparatively torpedo-proof cargo ships as soon as possible.

We should also, at the same time, consider whether it is worth our while to continue building large dreadnoughts, battle-cruisers, and the like, which cannot possibly be finished for years to come. Our ship building facilities are limited, and if the facilities now devoted to the construction of dreadnoughts could be immediately diverted to the construction of large fairly indestructible, high-speed cargo ships, which can be built in half the time, we would be taking a great step towards solving the problem.

So much for what might be termed the "defensive method" of attacking the problem. Along with this defensive plan, we should put into execution every practical offensive plan of attacking the submarine, *such as methods of detection when submerged, methods of attack by means of destroyers, mines, aeroplanes and special artillery.* All such methods should be, and probably are being developed, and while no one of them will prove to be the panacea by itself, collectively they will be of the greatest value in reducing the menace. However, I think it is well to emphasize the fact that the only safe and sane plan

(*Continued on page* 651)

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we publish such matter as is of interest to inventors and particularly those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

HUGHES RADIO BALANCE.

(189) Mr. Fred R. Bullis, Omaha, Neb., has submitted a very ingenious plan for using the regular Hughes balance for radio purposes, the idea being to upset the inductive balance by means of received wireless energy.

A. This indeed is a very good idea, and we are of the opinion that the apparatus will work as outlined by our correspondent. However, things of this nature had better be tested out under actual service, and we certainly would advise our correspondent to do so before applying for patent. We think he has the germ for an eminently practical device.

LAND SUBMARINE.

(190) Arthur J. Walsh of Montclair, N. J., submits designs and description of a submarine which can be used not only to operate under water but on land as well, the idea being to use it for offensive purposes, and the inventor seems to think that a device of this kind would be excellent for fording rivers, etc., where it would be impossible for the men to get across bridges or swim across.

A. While the idea is good, nothing new is contained therein, the trouble with a device of this kind being that a submarine for use on land, would have to be armored so heavily that it would be of doubtful value under water. The ordinary submarine has only a comparatively thin shell, and even a gun of rather small caliber will easily wreck the strongest present-day submarine if exposed from the water.

MODEL AEROPLANE.

(191) F. Paquette of Detroit, Mich., has been experimenting on a model aeroplane with two propellers, one in front and one in back. He claims to have had some success with this device, and wishes to know if an aeroplane so equipt could be patented.

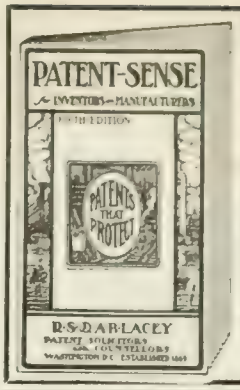
A. This idea is not new, and we doubt very much if a patent could be obtained on a device of this kind. There is nothing patentable in a device merely by transposing a certain function to the rear or to the front of the particular device.

CORKSCREWLESS CORK.

(192) Howard J. Heini of Lincoln, Neb., has been working on an improved cork, the underlying idea being that it is difficult as a rule to extract almost any cork from a bottle, and if a device could be found whereby a corkscrew could be made superfluous, the inventor thinks a valuable patent should result. Accordingly, he has submitted an idea whereby a cork, which could be made at a low cost, equipt with a certain device can be extracted without the use of the ordinary corkscrew; as a matter of fact, without any tool whatsoever, excepting the hands. Our advice is asked as to this idea.

A. Basically, we have no fault to find with this device. It is really excellent, altho a similar device, tho not quite the same, is now being used on certain perfumery bottles. The main fault we have to find with the device in question is that the metal which protrudes thru the cork comes in contact with the fluid or liquid contained in the bottle, and this is bad. If our correspondent could make his device in such a manner that no metal comes in contact with the fluid, we believe a good patent could be obtained.

Witness the fact that a fortune has been made out of the present new style, so-called "crown" bottle cap, which fifteen years ago was not known at all, and has been and is now in use all over the globe. This device was invented by a Baltimore man.



"The Book the Inventor KEEPS"

Worth more than all other patent books combined. FREE.

Write

R. S. & A. B. LACEY
131 Barrister Bldg.
Washington, D. C.
Established 1869

ARE *YOU* A REGULAR READER? IF NOT; WHY NOT?

Mr E Hume Talbert

PATENTS

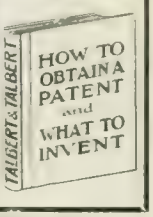
Send Sketch or Model of Your Invention for

Free Opinion as to Patentability

Our Certificate of Patentability is Evidence of Conception of your invention and may prove valuable to you. Our Credit System enables you to file your application for Patent and proceed without delay. Every case receives personal attention of a member of the firm.

Patents we secure advertised at our expense in Popular Mechanics Magazine.

This Book is Free



Talbert & Talbert, Patent Lawyers
4287 Talbert Bldg., Washington, D.C.

PATENTS WANTED

TRADE-MARKS and COPYRIGHTS

Largest Patent Firm in the World

Before sending your invention to any attorney or manufacturer or disclosing your invention write for our free blank form PROOF OF CONCEPTION in order to protect your invention and secure your rights. This should be signed and witnessed and returned to us, together with a model or sketch and description of your invention, and we will give a FREE OPINION as to the patentability of the invention. If we report the invention patentable we will furnish a Certificate of Patentability.

SPECIAL OFFER

This Certificate of Patentability, together with our blank form Proof of Conception will protect the inventor and serve as proof of the invention until the case can be filed in the U. S. Patent Office.

Victor J. Evans.

OBTAINING ASSISTANCE FOR INVENTORS—Our certificate is of great assistance to inventors who require financial aid to obtain patents

OUR FIVE BOOKS MAILED FREE

(See Coupon Below)

to any address. Send for these books—the finest publications ever issued for free distribution.

HOW TO OBTAIN A PATENT

Our illustrated eighty-page Guide Book is a Book of reference for inventors and contains 100 mechanical movements, illustrated and described. Tells how to invent for profit.

WHAT TO INVENT

Contains a valuable list of inventions wanted and suggestions concerning profitable fields of inventions; also information regarding prizes offered for inventions amounting to ONE MILLION DOLLARS

LIST OF PATENT BUYERS

Contains requests from manufacturers, mail order houses and promoters for patents secured by us and suggestions as to New Ideas they wish to purchase. We place our clients in touch with capital free of charge. We have recently received over 300 requests from manufacturers.

MILLIONS IN TRADE-MARKS

Shows the value of Trade-Marks and information regarding unfair competition

We advertise Our Clients' Inventions Free in a list of Sunday newspapers, in manufacturers' journals and in World's Progress. Sample Copy Free. We save you time and money in securing patents. After the patent is granted we assist you to sell your patent.

WANTED NEW IDEAS

FREE COUPON!

VICTOR J. EVANS & CO.

PATENT ATTORNEYS

New York Offices: 1001 to 1007 Woolworth Bldg. Pittsburg Offices: 514 Empire Bldg. Philadelphia Offices: 1429 Chestnut St.

Main Offices: 779 Ninth Street, N.W., Washington, D. C.

Name.. Address

EXPERIMENTERS!

Student's Chromic Plunge Battery

50c

HERE is a little battery that will be highly welcomed by every experimenter all over the country. It is the first low priced, as well as fool-proof chromic acid battery on the market. It is a little wonder, and for the small price we ask for it, it stands unmatched.

Now, we do not wish to mislead you, so we'll tell you at the start what this battery WILL NOT do. It will NOT charge storage cells, it will NOT run a large motor for hours, it will NOT run a big spark coil. It is NOT a very big battery.

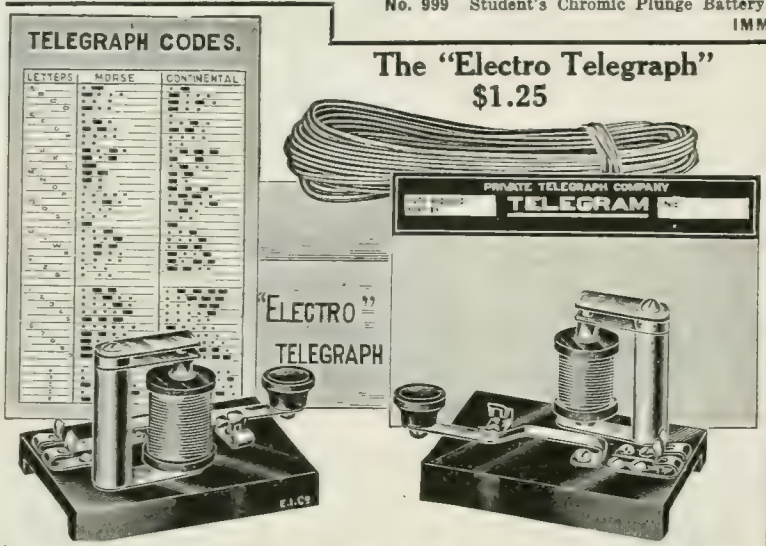
BUT it is an ideal battery for electrical experimental work where a very powerful current is not required. This battery will light a 2 volt lamp for several hours on one charge; it will run a small toy motor surprisingly well; it will do small electroplating work; it is ideal for testing work; it gives a fairly steady current, and as the zinc electrode can be pulled clear of the electrolyte, no materials are used when battery stands idle.

Only best materials go into the making of this battery. Best Amalgam Zinc only is used, as well as a highly porous carbon to ensure a steadier current. Handy binding posts are used. We furnish enough chromic salts for 4 charges. Full direction for operation and care of battery are included. Each battery tests 2 volts and 10 amperes when set up fresh. Not over 2 amperes should be drawn from battery continuously. By using six or eight of these batteries, a great many experiments can be performed. No solution can run out of this battery if upset by accident. This makes it an ideal portable battery, such as for operating a bicycle lamp, or as other portable lamp, where a powerful light is not required, for boy scouts' field telegraph work, operating telegraph outfits, etc., etc. Size over all is 5"x2". Shipping weight, 1 lb.

No. 999 Student's Chromic Plunge Battery..... **$0.50**

IMMEDIATE SHIPMENTS

The "Electro Telegraph" $1.25



is not a toy, but a practical, honestly built telegraph outfit, which not only sounds but works like the big commercial instruments. By studying the code for 30 days you can become a first-class telegraph operator. Such operators are in big demand now. Outfit consists of TWO complete telegraph instruments each measuring 3½ x 2½ x 2¼. All metal parts are highly nickel plated, including key lever. Note hard rubber knob. Telegraph Code Chart, telegraph blanks and connecting wire comes with set, but no batteries. Outfit works on 2 dry cells (one cell for each instrument). The "Electro" is the ONLY Outfit that works both ways, each station can call; no switches, no extras. Nothing to get out of order. Guaranteed to please you or money back.

Price Complete as Illustrated **$1.25**

At all good dealers and department stores. If your dealer cannot supply you send us $1.25 for outfit and add mailing charges for two pounds, otherwise we ship express collect. IMMEDIATE SHIPMENTS

BOYS!

Here Are the Stars and Stripes in All Their Glory.

Be the first one in your town to wear this patriotic emblem. Think of it: An electrically illuminated boutonnière worn in the lapel hole of your coat. It illuminates our National Flag in the original colors with a brilliant electric light. Just insert Flag in buttonhole of your coat, put flashlight case in vest or coat pocket and every time you press the button, the flag in your button-hole flashes up with a beautiful color effect.

Illuminated flag, cord and plug (to be connected to any 2 cell flashlight) **60c**

(Postage 10 cents.)

Illuminated flag, flashlight case and battery, cord and plug, complete as per illustration, $1.10; postage 15c.

DEALERS: Write for our proposition today.

IMMEDIATE SHIPMENTS

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 19 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 228 Big Pages, 600 illustrations, 500 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 19 measures 7x5¼". Weight ½ lb. Beautiful stiff covers.

"The Livest Catalog in America"

Now before you turn this page write your name and address on margin below, cut or tear out, enclose 6 cts. stamps to cover mail charges, and the Cyclopedia is yours by return mail.

THE ELECTRO IMPORTING CO.
231 Fulton Street New York City

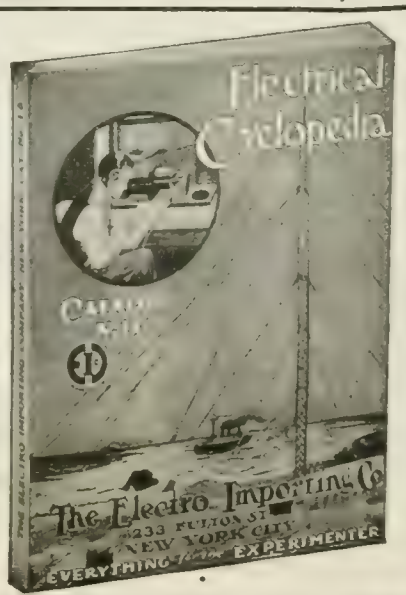
Electro Importing Company
231 Fulton St., New York City

I enclose herewith 6 cents in stamps or coin for which please send me your latest Cyclopedia Catalog No. 19 containing 228 pages, 600 illustrations and diagrams including Treatise on Wireless Telegraphy, complete list of all U. S. Wireless Call Letters, and 20 coupons for your 160 page Free Wireless Course in 20 lessons.

NAME .....

ADDRESS .....

STATE .....E. E. 1-18



CHEMICAL EXPERIMENTERS

Be sure to get the catalog illustrated to the left. It contains the greatest chemical experimental assortment of any catalog in print. There are close to 20 pages, containing several hundred chemical apparatus such as Reagent Bottles, Crucibles, Water Bath, Tripods, Blow Pipes, Chemical Scales, Glass Retorts, Chemical Thermometers, Glass Rods, Beaker Glasses, Test Tubes, Funnels, Thistle Tubes, Disiccating Jars, Wash Bottles, etc., etc.

Also a complete line of Chemical Laboratories from $2.00 up to $90.00.

Full line of popular chemicals as used by students.

Be sure to get a copy of this catalog today without fail.

WAR ADDRESS BY A. I. E. E. PRESIDENT-ELECT E. W. RICE, JR.

(*Continued from page 648*)

of action is to assume that we can only win by pushing the development of all practical looking methods of attack and defense, at the same time, and to the limit of our ability.

Now I am well aware that there is nothing theatrical or startling, or novel, in the above suggested solution. For this reason it is not likely to appeal to the great non-technical public, but there is no doubt in my own mind that it represents the scientific and common-sense method, and that if followed with *patience, persistence, vigor and diligence, it will prove successful, and if successful, the war cannot be lost.* All the other problems of the war—the aeroplane, army, navy, food, manufacturing, farming, transportation, etc.—can be successfully solved by the same scientific, but simple and common-sense methods.

It is a great satisfaction to notice that this country has at last awakened to the importance of developing that great American invention—the aeroplane, and of manufacturing it on a great scale. We should do everything to help accelerate this work. If we can get aeroplanes of the right kind to Europe, soon enough and in sufficient quantities, experts tell us that it will do more to win the war than a large army.

We must also not neglect the development of the submarine, because if we fail to find a way to drive the submarine from the seas in short order, and fail to make relatively unsinkable and uncatchable ships, we may have to rely on big freight submarines, properly convoyed by fighting submarines, if necessary, in order to get food, material and soldiers to Europe.

We must not forget that, after all, all these things must be done by men collectively and that, therefore, it is essential for us to think and act collectively, and with reasonable unanimity. We must co-operate and not nullify our power by quarrels among ourselves. This means that we must be willing to give consideration to the views of others, be ready to make reasonable compromises and be constantly actuated by a spirit of conciliation. We must make every effort to get men of great experience, industry and sound common-sense in positions of trust and influence.

"HAM" AERIALS.

(*Continued from page 616*)

Speaking of using phoney stunts for aerials reminds me of one stunt I tried which worked fine. This was to put insulators in the wire clothes lines on the roof and use them for sending and receiving. All went well for some time till the maid came down stairs and said that the clothes were sparking, and every time she touched them she got a shock. I had to go up with her in order to prove that nothing was wrong and that she only *imagined it.* Some fun, but say, when wet sheets were hung up signals came in better and if you wanted to know if the clothes were dry, just listen in and you could tell by the way signals died out that the sheet was dry. Guess I will have to take out a patent on that idea.

How many have had aerials mysteriously disappear? I have, and to warn me when they think of leaving, I have the greatest little alarm you ever heard of and which lets you know just the minute anything happens. By twisting an enameled wire with the aerial wire and connecting it at the aerial switch with a constant ringing bell and special relay, cutting the wires

(*Continued on page 652*)

PATENT ADVICE.

(*Continued from page 649*)

ONE BRUSH MOTOR.

(193) C. W. Halligan, Ephrata, Pa., has submitted to us a sketch showing an induction motor using only one brush and a 12-segment commutator. The armature coils are connected in such a manner that when a coil is in a certain position its ends are short-circuited by the brush. Advice is asked if such a motor would be of any commercial value.

A. For the reason that only one armature coil could be used, the losses would be too great, and therefore no commercial advantage is perceived in this device. While there would be a slight advantage of using only one brush instead of two brushes, this advantage is offset by the occurrence of other losses. Besides, brushes are so cheap that it would not pay to change the construction of the machine merely to save the cost of a cheap brush.

PHONOGRAPH.

(194) Wm. Tredwell, Glace Bay, Nova Scotia, has an idea whereby he wishes to equip the horn of an ordinary phonograph by means of a blower or fan arrangement, the idea being that he expects to obtain the same effect as that used in an ordinary organ, better known by the name of *Vox Humana.*

A. While this looks good on paper, and while the idea ceretainly appears new, it is impossible to say if the device would work or not without actually trying it out. We would advise our correspondent to first build a model before spending money on patents.

RANGE FINDER.

(195) Herbert L. Moershfelder, Buffalo, N. Y., submits drawing and specifications of a mirror range finder to be used in conjunction with a telescope to find the range of ships, etc., accurately. Our advice is asked as to the patentability and practicability of the device.

A. While several points of the idea as submitted are rather novel, there is a very similar range finder in operation now on United States battleships, and for this reason, we doubt very much if protection could be secured on this particular idea.

AUTOMATIC WRENCH.

(196) Joseph Denninger, Germantown, Philadelphia, Pa., has sent in a sketch of a ratchet wrench on which he wishes to have our opinion. This particular wrench is made in such a manner that any jaw opening may be had and secured at a particular point merely by pressing a spring.

A. This idea strikes us as being very good, and we have not run across anything quite the same. It seems also rather cheap to produce from a manufacturing viewpoint, and we think a good patent might result. Our advice is to get in touch with a patent attorney.

Rider Agents Wanted

Everywhere to ride and exhibit the new **Ranger "Motorbike"** completely equipped with electric light and horn, carrier, stand, tool tank, coaster-brake, mud guards and anti-skid tires. **Choice of 44 other styles,** colors and sizes in the famous **"Ranger"** line of bicycles.

DELIVERED FREE on approval and **30 DAYS TRIAL.** Send for big **free** catalog and particulars of our *Factory-direct-to-Rider* marvelous offers and terms.

TIRES Lamps, Horns, Wheels, Sundries, and parts for all bicycles—at half usual prices.

SEND NO MONEY but tell us exactly what you need. Do not buy until you get our prices, terms and the big FREE catalog.

MEAD CYCLE COMPANY Dept. L107, CHICAGO

PATENTS

THAT PROTECT AND PAY

Books and Advice Free

If you want to sell your patent, take it out through my office. HIGHEST REFERENCES. BEST RESULTS

WATSON E. COLEMAN, Patent Lawyer

524 F. Street, N. W. Washington, D. C.

PATENTS

Send me your ideas. Manufacturers want patents I procure. Prompt, confidential, personal service by successful patent attorney with highest references. Honest advice and "The Truth About Patents" Free.

J. R. KELLY, 740D Woodward Bldg., Washington, D. C.

EVERY INVENTOR

should have this book, "PATENTS AND PATENT POSSIBILITIES." It is chock-full of ideas and practical advice, telling what to invent and where to sell. Write for your copy today. IT IS FREE.

I have requests for patents upon sound inventions of all kinds. Can you help supply the demand?

My service is individual, prompt and efficient (14 years experience). Every expedient is employed to secure patents at least possible cost.

H. S. HILL, 804 McLachlen Bldg., Washington, D C

Patents

procured by a former Examining Official of the U. S. Patent Office, Norman T. Whitaker, Attorney-at-Law and Mechanical Engineer, 480 Whitaker Bldg., Washington, D. C. Inquiries invited.

ELECTRICAL ENGINEERING

men with training are always in demand. Having trained over 2000 young men in the past 23 years in the fundamentals of Applied Electricity, THE BLISS ELECTRICAL School, with its well equipped shops and laboratories, is peculiarly well qualified to give a *condensed course* in Electrical

including Mathematics, Steam and Gas Engines, Mechanical Drawing, Shop Work and Theoretical and Practical Electricity, in all branches. Students actually construct dynamos, install wiring and test efficiency of electrical machinery. Course, with diploma, complete

IN ONE YEAR

For practical young men with limited time. 35th year opens Sept. 26th. Catalogue on request.

260 Takoma Avenue, Washington, D. C.

A BARGAIN

$3 Cash with order buys this **BENCH LATHE**

Swing 3 in. 8 in. C. to C. Shipping Wt. 10 Lbs.

Peter Austin 910 W. First E E. Muncie Ind.

ORDER NOW

SMALL ENGINES

Perfected Gasoline Engines—½, 1 and 1½ h p for Farm and Shop use. Price $19.50 and up. Also

WASHING MACHINES

We ship on trial. Send for Booklet and Special Offer

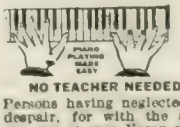
Sieverkropp Engine Co., 1401 19th Street Racine, Wis. *Starter for Ford Cars*

Feldman's "Geyser" Electric Water Heater

Instantaneous Hot Water

FELDMAN MFG. CO.

1514 Times Bldg. New York City

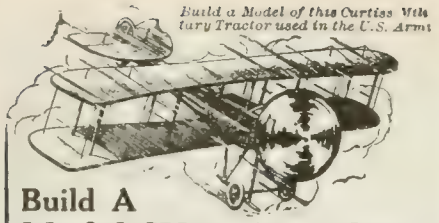


NEW VAMPING CARD

NO TEACHER NEEDED--SURPRISINGLY SIMPLE SYSTEM

Persons having neglected their Musical Education need not despair, for with the aid of our new VAMPING CARD you can at once Vamp away to thousands of Songs, Ballads, Waltzes, Rag Time, etc., etc., equal to a Professional Musician. No knowledge of music required. After using it a few times, you will be able to dispense with the aid of the Vamping Card entirely. Price only 15 cts. postpaid.

JOHNSON SMITH & CO., Dept. 823 54 W. Lake Street, CHICAGO



Build A Model War Aeroplane!

It's easy! With "IDEAL" Accurate Scale Drawings and Instructions you can build a 3-foot Model Aeroplane that looks like a real one and that will rise from the ground by its own power and fly 50 to 100 feet. It's a great summer sport, and you can learn a lot about Aeroplanes and how they fly. Send for the Drawings and Instructions for the one you want to build.

Curtiss Military Tractor
Bleriot Monoplane
Nieuport Monoplane
Taube Monoplane

25c EACH (8 for $1.75)

Wright Biplane
Curtiss Hydroplane
Curtiss Flying Boat
Cecil Peoli Racer

"IDEAL" Aeroplane Construction Outfits, containing all parts and material needed to build these Aeroplanes, are sold by Leading Toy, Sporting Goods and Department Stores. Ask your dealer for "IDEAL" Aeroplane Construction Outfits.

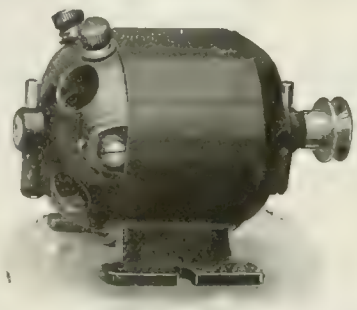
Send 5c For This Catalogue

Tells about Model Aeroplanes and what you need to build them with. 48 pages of useful information—send 5 cents for it right away.

IDEAL Model Aeroplanes

IDEAL AEROPLANE & SUPPLY CO.,
76-82 West Broadway, New York

1-50 H. P. MOTOR, $4.75



COMPLETE WITH CORD and PLUG
115 VOLTS A. C. or D. C.

This is your chance to get a small motor at a low price. We have only a limited quantity available at this price. Order yours to-day.

BODINE ELECTRIC CO.
2254 W. Ohio St. Chicago, Ill.

The Electrical Worker Needs This Tool For Cutting Condenser Plates

Zip! And you cut out a condenser plate from plain glass with this genuine "Red Devil" Glass Cutter. Has manifold uses besides—handy in repairing window and picture frames, making table tops, lampshades, etc.

"RED DEVIL" GLASS CUTTERS

Cut more glass with less pressure and breakage than any other cutters. Used by all skilled glaziers.

To be obtained from hardware dealers, or if not, send 10c for sample, style 024.

Glass cutter booklet free

Smith & Hemenway Co., Inc.
107 Coit Street Irvington, N. J.

shorts them and the bell starts to buzz. The aerial switch of course must have extra blades or contacts on it, so that when you are sending, the enamel wire is connected to the aerial wire and acts for the time as part of the aerial. I even went so far as to use two enamel wires and by using them as a closed circuit system, plus the first system, which is known as an open-circuit one, I was positive that nobody could walk away with any of my wire. Shorting the enamel wires to the lead-in was just as bad as cutting, as all the alarm apparatus down in the house was of the type where, once a circuit was made or broken, the bell kept on ringing. In case I did not happen to be at home the device was so arranged that besides the bell, which only rang for about ten minutes, the transformer would be connected to the aerial and just enough shock given to make it unpleasant for the cutter and yet not kill him. This also was arranged to be shut off after ten minutes' time. Well you say, all the cutter had to do would be to return in that time and finish the job. Correct!! but I don't think that, not knowing that the juice would be turned off and thinking that some one was using the set, would cause him to return. The act of cutting aerials is one of the lowest in the whole category of petty larceny crimes and as for the money paid for insulators and old wire I guess it is about enough to take a trolley ride and that's all.

Talk about playing clean jokes on the other fellow, I pulled one that works great. It is performed in this manner:—For some time tell the party who is to be the goat, that you have invented a "Wireless Telephone" and after pulling this line of chatter for a time, fix yourself up with a telephone transmitter, battery and receiver and not forgetting to mention that he will hear you on such and such a night at a certain time, go up on his roof and make a ground connection on a vent pipe and the other to his lead-in wire. This will complete the circuit and by talking, he will hear you thru his receiving set. It would work better if you had a talking coil with the receiver in the secondary and the transmitter in the primary; then when you connect your wire to his lead you will not have the battery current flowing thru his receiving set and make a 'click in his 'phones which may put him wise, if he knows anything about electricity. Call him up and ask him how he likes your new wireless telephone, but be sure to disconnect your clip from the lead and by having it lay near the aerial lead you can hear thru your receiver what he says. "Kid" him along for a few nights and your fame in the amateur world will grow. If the other fellows say that they can't get you at the same time, "gas" a little about *directional effects.*

HIGH POTENTIAL BATTERIES FOR AUDIONS.

(*Continued from page* 614)

("1") puts in the first cell, and thereafter the potential difference between the terminals rises by approximately equal steps of about 1.4 volts as the handle is rotated, until all the cells are included in the circuit.

The larger cells are recommended as having a longer life than the small ones, but the arrangement is not quite so compact. Any cell can readily be slipt out of the springs which hold it. It is thus easily replaced by a new one—there is no soldering to be done or screw connection to make.

ELECTRICITY IN 4 MONTHS

America's oldest and largest practical institution. You are trained thoroughly and quickly to hold a big paying position in this wonderful field of Electricity. No books, no classes. All practical training under expert instructors. We have made arrangements for students to earn part of their expenses while learning.

COYNE TRADE AND ENGINEERING SCHOOLS
18 Years of Success

Practical training in Mechanical Drafting and Machine Design, Architectural Drafting, Structural Drafting, etc. Prepares you thoroughly to step into a good position. Open all year, day and evening. Enter any time. Earn while you learn. Write for free book now. Add. Dept. 1501
39-51 E. Illinois Street, CHICAGO, ILL.

DRAFTING IN 3 MONTHS

PREPARE AT ONCE TO SERVE WITH

TELEGRAPHY

ON LAND OR SEA, IN ARMY, NAVY, TELEGRAPH OR RAILROAD COMPANY, MERCHANT MARINE OR AVIATION SERVICE

LANDLINE OR RADIO
COMPLETE AT
Eastern District Y.M.C.A.
Marcy Ave., near Broadway, Brooklyn
Send for folder F

WITH this new Electrical Wonder you get the pleasant effect of a massage and a shave at the same time. This razor is on the market and we are shipping to all points in the United States and South America.

This device can be used without electricity like the ordinary safety razors, but is supposed to be used with alternating current. The blade moves 7200 times per minute and actually cuts the hair without pulling.

Vibrating Electric Razor Co., Omaha, Neb.

RADIO OPERATORS NEEDED

Government Service Merchant Marine

Wonderful opportunities offered daily. Complete course of instruction under expert teachers in shortest possible time.

Special Women's class now forming

Complete Equipment—Low Rates—Individual Instruction — Rapid Progress — Dormitories—Employment Bureau.

START TODAY

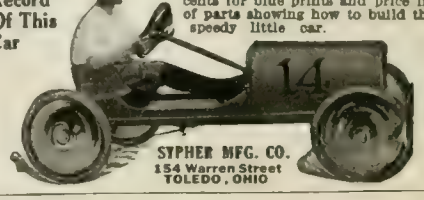
Write for Illustrated Booklet.

Y. M. C. A. RADIO SCHOOL
145 E. 86th Street, New York, N. Y.
BEST RADIO SCHOOL IN NEW YORK

35 MILES PER HOUR

Is Record Of This Car

Built by a boy from Junior parts furnished by us. Any boy can build this car. Parts very cheap. Send 26 cents for blue prints and price list of parts showing how to build this speedy little car.



SYPHER MFG. CO.
154 Warren Street
TOLEDO, OHIO

Build Your Own PHONOGRAPH

It's Easy With Our Help

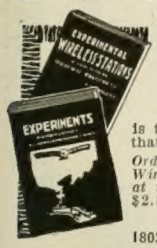
A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

Write Today for Our Free Blue Print Offer. Agents wanted for our ready built Choraleons.

SAVE OVER HALF

CHORALEON CO.

701 Monger Bldg., Elkhart, Ind.



Science startles the world these days

"Experiments"

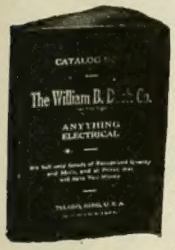
By Philip E. Edelman

is the big fully illustrated 256 Page book that tells about it so you understand. $1.50.

Order Edelman's famous "Experimental Wireless Stations," new 272 Pp. ed., $1.50 at the same time and get both books for $2.85. The ideal gift. Guaranteed.

P. EDELMAN, Pub.

1802 Hague Ave., St. Paul, Minn.



DUCK'S

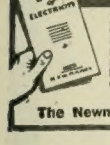
BIG 300pp. ELECTRICAL and WIRELESS CATALOG

Mailed upon receipt of 8c in stamps or coin which may be deducted on first dollar purchase. Catalog contains 160 pages of wireless instruments and 140 pages of electrical supplies. No bigger or better values are obtainable elsewhere. We have a complete stock of everything listed in this catalog. Wireless orders promptly filled.

THE WILLIAM B. DUCK CO.
230-232 Superior St. Toledo, Ohio

POCKET BOOK of ELECTRICITY

SPECIAL WAR EDITION FREE



Distributed as a supplement to our big Handy Book during temporary government suspension of wireless. Lists new things to experiment with. Also, motors, flashlights, telegraph apparatus, puzzles, magic outfits, books, athletic goods, chemical sets, fishing tackle, novelties. Handy, interesting. For every boy in America. *Free on Request.*

The Electro-Set Co., *now known as*
The Newman-Stern Co., *Dept. E. 20* Cleveland, Ohio

Convert Your Bicycle Into a Motor-Cycle

We sell you the motor complete or furnish you with the finished parts from which you can build the motor yourself with few tools. We send you the printed instructions with blue prints of the drawings for $.25 or full particulars for 3-cent stamp.

STEFFEY MFG. CO., 5025 Brown St., Phila., Pa.

MAKE YOUR OWN GENERATOR!

We have a complete line of sturdy efficient generators and alternators from 100 to 1000 watts. We furnish these complete, or parts furnished ready to assemble with wire and instructions to wind. Send for catalogue.

ALL AT FACTORY PRICES.

BERGMANN MOTOR WORKS, 1283 NIAGARA ST., BUFFALO, N. Y.

LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, **emits rays of white light, rendering it perfectly visible in the dark. THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles; make your own Luminous Crucifixes, Luminous Rosaries, etc. Bottle containing sufficient to coat several small articles, **Price 25c. Larger sizes 50c and $1 postpaid. Johnson Smith & Co., Dp. 923. 54 W. Lake St., Chicago**

GOOD hand generators which we will sell at bargain prices. Give up to 110 volts A. C. Easily made

GENERATORS

direct and crank replaced by pulley if desired. While they last, $3.00 each.

Here is your chance to get a good generator ***CHEAP!***

Watson Electric Co., 868 Gas Bldg., Chicago

THE ULTRA-MICROSCOPE AND THE UNDERWORLD OF INFINITESIMAL SMALL.

(*Continued from page 623*)

Zsigmondy* thus describes colloidal gold as viewed thru the ultra-microscope:—

"The tiny gold particles did not swing stationary in the water, they moved with astonishing rapidity . . . These motions show that there is a continual mixing together of the interior parts of every liquid going on unceasingly, year in, year out. . . . The smallest observable gold particles show a double motion; firstly, they possess a motion of translation so rapid that the particles travel 100 to 1000 times their own diameter in 1/6 to 1/8 of a second; secondly, they possess a swinging or oscillatory motion of much shorter period; indeed it is probable that they possess oscillatory motions of higher order and smaller amplitude, too small and too rapid for direct observation."

This his description of colloidal silver:—

" . . . Blue, violet, green, and red particles, in different shades and with a rare brilliancy of color, are seen in ceaseless movement. One particle approaches the other, circles round it in a rapid zigzag movement, and then flies off again. Sometimes several particles group together and dance like flies in the sunshine, especially when, for a fraction of a second, one particle comes near another."

He thus describes the coagulation produced by adding sodium nitrat to colloidal gold:—

"Suddenly there appeared yellow balls of mist, in a state of wave motion. The mist condenses further. One sees the tiny individual particles in a state of lively Brownian movement. The particles rush together and revolve round their common center of gravity . . . if the saltpetre solution be allowed to flow into the gold solution under the microscope, such rapid and violent whirlpool motions are set up that the eye is unable to follow the process of coagulation."

The movements described by Zsigmondy are, no doubt, similar to the swifter and more complicated molecular motions of matter. In the future, man must find some means to retard these motions before the particles can be viewed, and it is highly probable that this will be accomplisht by some process of excessive cooling.

*Zsigmondy, "Kooloidie und ultra-microskopie" (1905), Elektrochemie VIII. 684-87 (1902), Physik. Ch. LVI. 65-82 (1906).

EXPERIMENTAL MECHANICS.

(*Continued from page 621*)

drilling can be done just as well on the lathe), yet at times when drilling on the lathe is not possible, the drill press will be found indispensable. As with the other machines, the size will depend upon the character of the work, and the amount to be expended by the purchaser. There are several types on the market and the writer advises that the motor-driven type should be invariably employed. A small ⅛ H.P. motor will be sufficient for driving a small drill press.

If the amateur goes to an extreme and desires to make his shop up-to-date, then he will invest in a small *milling machine*, a *bench shaper* and a *circular saw*.

Having outlined the necessary equipment to make up a fully equipt up-to-date workshop, we shall proceed hereafter with the details, as to the how and why of handling the various tools. The author will treat in the second lesson on the "Lathe."

Make a NEW MAN of YOURSELF for the NEW YEAR!

ARE you going to be a failure all your life or are you determined to be a

BIG SUCCESS THIS YEAR?

Are you going to stay a weakling with flabby muscles, undeveloped body, poor digestion, or are you going to MAKE yourself STRONG, VITAL and SELF-RELIANT?

Abraham Lincoln said "prepare yourself for your big chance and it will come." No man wants a weakling for a big job. PREPARE YOURSELF NOW.

HEALTH—STRENGTH—VITALITY

Are you too fat or too thin? Are your organs weak? Have you a good appetite?

RESOLVE TO BE FREE

from your shackles of Ill-Health. No matter what your ailment STRONGFORTISM will help you overcome it.

Here is a practical system of health and body building fitted to your individual needs by LIONEL STRONGFORT the strongest physical culture expert in the world.

The cost is moderate, instructions personal. Write me today; tell me just what your weakness or your ailment is and I will show you how to grow strong, robust, SUCCESSFUL. Before you do anything else write me now for a FREE copy of my book INTELLIGENCE IN PHYSICAL AND HEALTH CULTURE, and send 6c. in stamps to cover mailing expenses.

STRONGFORT the Perfect Man

LIONEL STRONGFORT
MASTER OF PHYSICAL CULTURE
387 PARK BUILDING, NEWARK, N. J.

NEW BOOK ON

ROPE SPLICING

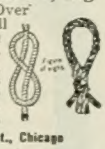
Useful Knots, Hitches, Splices, etc.

How Different Knots Are Made and What They Are Used For

INDISPENSABLE TO EVERY MECHANIC AND RIGGER

PRICE **20c**

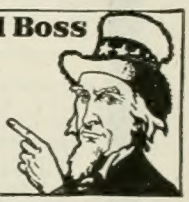
A most practical handbook giving complete and simple direction for making all the most useful knots, hitches, rigging, splices, etc. Over 100 illustrations. All about wire rope attachments, lashing, blocks, tackles, etc. 37 Heraldic Knots illustrated. Of great value to mechanics, riggers, campers, boatmen. **Price 20 cents postpaid.**



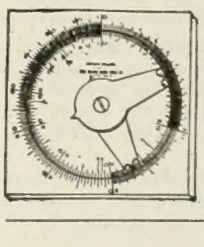
JOHNSON SMITH & CO., Dept. 923, 54 W. Lake St., Chicago

Uncle Sam is a Good Boss

He pays good money and the jobs are pleasant, dignified and good for a lifetime. Why not try for a good government job? The examinations are not hard to pass if you let the International Correspondence Schools show you how. Write today for booklet which tells how hundreds have got positions. It's *free* and without obligation.



International Correspondence School
Box 5369 Scranton, Pa.



THE MIDGET SLIDE RULE

will add, subtract, multiply, divide, solve problems involving even and uneven roots and powers. It will also give the Logarithms of numbers and the Sines, Cosines, Tangents and Cotangents of all angles.

Its operation is very simple and with this instrument one can quickly solve any mathematical problem. This slide rule is made of wood and metal and it is adapted for shop work as well as office use.

Size 3 1-4 x 3 1-4 in. Price, with Instructions, 75c. Your money back if you are not satisfied. GILSON SLIDE RULE CO., Niles, Mich.

WANTED — Railway Mail Clerks

Commence $75 Month
Increase to $150 "
Common Education Sufficient
Sure Pay.
Life Job.
Pull Unnecessary.

COUPON

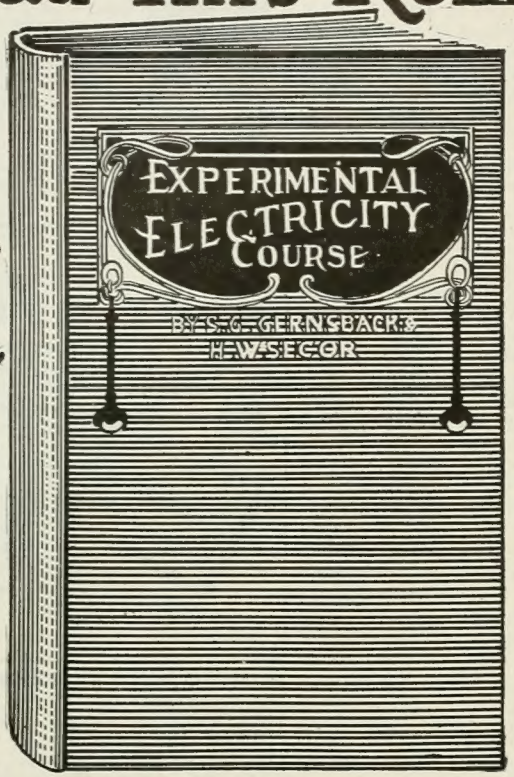
Franklin Institute
Dept. K103
Rochester, N. Y.

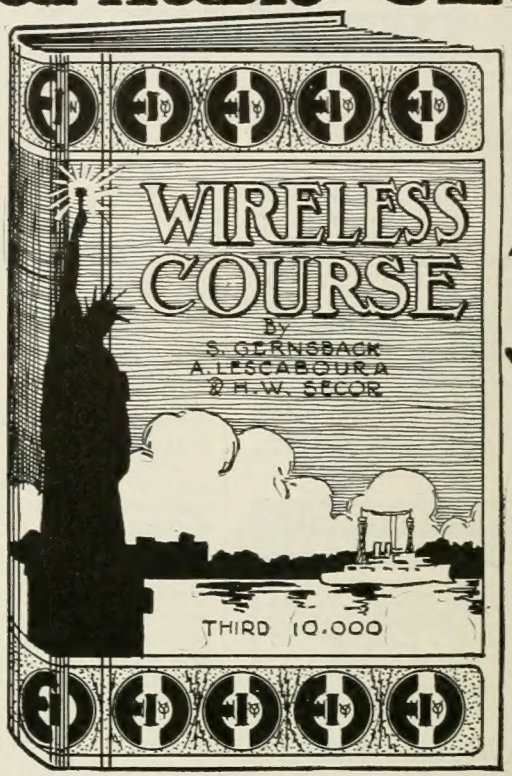
Sirs: Send me, without charge, (1) sample Railway Mail Clerk Examination questions; (2) schedule showing places of Spring examinations; (3) list of many other government jobs now easily obtainable and (4) free book describing them.

Name .....
Address .....

Free to You!

Read this Remarkable Offer!





This masterpiece contains 160 pages, 400 illustrations. Size of book 5"x9". Printed on extra thin paper, so book can be slipped in pocket. Handsome stiff cloth cover. **FREE** with a year's subscription.

The most comprehensive Wireless Course ever printed. Contains 160 pages, 350 illustrations. Size of book 6½" x 9". Very fine flexible linen cover. **FREE** with a year's subscription.

This is a very limited offer. It may be withdrawn at any time, due to the tremendous cost of paper, which IS JUST DOUBLE WHAT IT WAS ONE YEAR AGO. We only have about 2000 each of these fine books on hand; after they are gone we cannot reprint the books until conditions become normal again. THIS MAY BE TWO YEARS OR MORE. **Now is your chance.**

The publishers of this journal have earned an enviable reputation of giving more than 100 cents' worth for each dollar spent with them. Profit by this liberal opportunity NOW; it may never be made again.

HERE'S THE OFFER

Subscribe to THE ELECTRICAL EXPERIMENTER for one year, at the **regular subscription price** of $1.50 per year (Canada, foreign and N. Y. C. $2.00) and we will send you FREE, POSTPAID, either one of the above books. If you subscribe for two years, BOTH BOOKS WILL BE GIVEN FREE, POSTPAID.

If you are a subscriber at present, take advantage of this wonderful opportunity anyway. If you do, we will extend your present subscription for one year.

This Offer Limited. Act Now.

EXPERIMENTER PUB. CO.,
223 FULTON STREET
NEW YORK CITY

FILL IN — TEAR OUT — AND MAIL

1-18

Gentlemen:

Please enter my subscription to THE ELECTRICAL EXPERIMENTER for the term of.....year..... for which I enclose herewith $.....
You will also send me at once FREE prepaid your.....book....

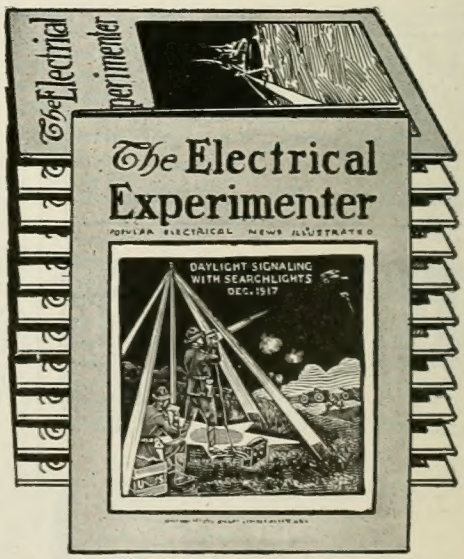
.....

.....

Name .....

Address .....

.....



12 copies of THE ELECTRICAL EXPERIMENTER make a book 9" x 12" and 4" thick. This book will weigh 7 lbs. It is the greatest Electrical and Wireless reference work in the world. **And all for $1.50**

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section six cents a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the February issue should reach us not later than December 23.

OVER 90,000 PEOPLE READ THIS JOURNAL

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

AERONAUTICS

AERIAL AGE, America's leading illustrated weekly, presents the latest developments in aeronautics throughout the world. Up to the minute technical information concerning aero-engines, aeroplanes, accessories and patents. Complete model news and instruction. Trial subscription six months, twenty-six issues, one dollar. Sample copy 10c. Aerial Age, 280 Madison Ave., New York City, N. Y.

AUCTIONS

AUCTIONEERS make from $10 to $50 a day. Free catalog. Missouri Auction School, Kansas City.

BOOKS

TO GET BETTER PICTURES: Read the Amateur Photographer's Weekly; illustrated; weekly prize competitions; print criticisms; many unique features; $1.50 per year; three months' trial subscription 25c.; Abel Publishing Company, 401 Caxton Bldg., Cleveland, Ohio.

30 MAGAZINES—All different, late issues. Value $3. Yours, only 25c prepaid. Eastern Bureau, New Egypt, N. J.

A BINDER for THE ELECTRICAL EXPERIMENTER will preserve your copies for all time. Price, 50c. Postage on 3 lbs. is extra. Send for one today. Experimenter Publishing Co., 233 Fulton St., New York City.

FIRE SALE OF SLIGHTLY DAMAGED BOOKS. Due to fire in our stock rooms, a great many of our books were water stained, but not otherwise damaged. Rather than dispose of them to dealers we prefer to give our readers the benefit. Look at this list! Our celebrated Wireless Course, 160 pages, 400 illustrations; Experimental Electricity Course, 160 pages, 350 illustrations; How to Make Wireless Sending Instruments. These three books for $1.00 prepaid. Regular selling price of these three books is $2.50. We guarantee you will be satisfied. Experimenter Publishing Co., Inc., 233 Fulton St., New York City.

OLD E.E. BACK NUMBERS—We have some valuable old E.E. back numbers on hand as per list below:

1915.				July	... price	each	$.20
Jan.	....price	each	$.25	August	.. "	"	"
March	.... "	"	"	Sept.	.... "	"	"
April	.... "	"	"	Oct.	.... "	"	"
May	.... "	"	"	Nov.	.... "	"	"
June	.... "	"	"	Dec.	.... "	"	"
July	..... "	"	"				
August	... "	"	"	**1917.**			
Sept.	.... "	"	"	Jan.	.... "	"	.15
Oct.	..... "	"	"	Feb.	.... "	"	"
Nov.	.... "	"	"	March	.... "	"	"
Dec.	.... "	"	"	April	... "	"	"
				May	.... "	"	"
1916.				June	.... "	"	"
Jan.	.... "	"	$.20	July	.... "	"	"
Feb.	..... "	"	"	Aug.	.... "	"	"
March	.. "	"	"	Sept.	.... "	"	"
May	.... "	"	"	Oct.	..... "	"	"
June	.... "	"	"	Nov.	.... "	"	"

We can fill orders at once upon receipt of your remittance and if you have not these numbers already now is your chance to get them as they probably will be snapped up very quickly. Experimenter Publishing Co., 233 Fulton St., New York City.

BUSINESS OPPORTUNITIES

SPECIAL OFFER—Luminous Paint, 15c; Silver-plating Powder, 15c; Liquid Courtplaster, 15c; Soap Bubble Liquid, 15c; Straw Hat Bleach, 15c; Collapsible Tube Tooth Paste, 15c; Resilvering Mirror Liquid, 15c; Polish for Tan Shoes, 15c; Dressing for Tan Shoes, 15c; Paint to Make Oil Cloth, 15c. Full Directions how to make and use. Full set of 10 only 50c. Remarkable bargain. Stamps accepted. Sidney Specialty Co., 233 S. Fulton St., New York City.

CHEMICALS

PREPAID 80 DIFFERENT CHEMICALS, $3.00—Mercury, Sodium, Iodine, Magnesium, Aluminum, Uranyl-Chloride, Silver Nitrate, Mercuric-Oxide, Zinc Dust, Iodoform, Manganese Dioxide, Calcium Sulphide, Hydrochloric, Oxalic and Acetic Acids together with 65 others. All are contained in glass stoppered bottles. Generous quantities of each. We do this to advertise the purest chemicals manufactured. Full list sent free upon request. Sent prepaid to any address in the world, $3 complete. C. O. D. terms accepted. The Swimmer Chemical Co., 1904 Park Place, Brooklyn, N. Y.

ELEC. SUPPLIES & APPLIANCES

SPRING CALIPERS. Inside. Outside. Dividers. 4-inch size. Set of three, $1. Money-back guarantee. Every mechanic needs this set for accurately working. LARKIN COMPANY, 1988 Bedford Ave., Brooklyn, N. Y.

PROPELLERS—4 to 12 inches, 5 cents per inch. E. McCabe, 1188 Albion Ave., Chicago, Ill.

MOTORS—Forced sale of ¼ H.P., 110 volts, 60 cycle, A. C. Brand new, never unpacked. Guaranteed perfect, $22. ½, $42. Few at $12 and $30. Lincoln Supply Co., Lincoln, Pa.

AT LAST! A microphone for controlling toys, etc., by the voice. Special French Imported Microphones complete and ready for use, only $3. They will control by means of the voice, toy trains, dogs, submarines and submarine signalling work. The only ones in this country. Have also one Roller-Smith ammeter 0-15, $4. D.P.D.S. switch of Western Electric make, $1 complete. Ives D.C. motor control, $4. One 14-in., 110-volt fan, $10. Lots of other things, write. Samuel Cohen, 1936 Pitkin Ave., Brooklyn, N. Y.

WIRE YOUR HOME FOR ELECTRIC SERVICE. Let us estimate on your home, and quote our price on the materials required. Special Discount. Send for particulars. Baer Electric, Van Wert, Ohio.

HIGH FREQUENCY OUTFITS — Complete (less batteries), $9. 15,000 metre loading coils, $5.50. Also 1½" Spark Coils, $3.50. C. O. D. terms accepted. J. C. Swimmer, 1904 Park Place, Brooklyn, N. Y.

HELP WANTED

BE A DRAFTSMAN—Pleasant work; salary $100 to $200 a month. Study at home in spare time; we will help you secure position when qualified. Send today for particulars and liberal offer. Drawing outfit FREE to every student. COLUMBIA SCHOOL OF DRAFTING, 223 McLachlen Bldg., Washington, D. C.

U. S. Government wants help. Men-Women, 18 or over. War preparations compelling thousands appointments, $90 month. Easy clerical work. Short hours. Vacations with pay. Common education sufficient. Write immediately for list and description of positions, Franklin Institute, Dept. K 27, Rochester, N. Y.

MISCELLANEOUS

MAIL COURSE, arm movement Penmanship, one dollar. Moose Correspondence School, Warner, Ohio.

STAMPS—61, all different, free. Postage, 3c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

WE HAVE a limited number of beautiful art pictures of the following famous electrical men on hand. Nikola Tesla, Dr. Lee De Forest, Guglielmo Marconi, Charles P. Steinmetz and Reginald A. Fessenden. These make a handsome decoration for any laboratory or workshop and should be prominently displayed. Price for five, prepaid, 25c. Experimenter Pub. Co., 233 Fulton St., New York City.

BIG BARGAIN IN TENNIS RACKETS—We have a small supply of Tennis Rackets, made by one of the largest firms in the country, on hand which we will close out at the following prices:
No. 2375—Extra best Tennis Racket, $5 grade, air dried ash, popular long oval form, concave walnut wedge, superior quality of gut; each, $2.75.
No. 2377—First grade Tennis Racket, second growth ash, walnut and maple throat, very good grade of gut; handle of cedar with leather cap; a $3.25 grade; each $1.85.
No. 2376—Medium grade Tennis Racket made of the same stock as No. 2377 except the gut. A perfect $2.25 grade. Ideal for beginners. Each $1.35. Shipping weight of each size two pounds. Send for one today. Our stock is limited and policy is: "First Come, First Served." Don't forget to include money for postage, or we ship express collect. The Electro Importing Co., 233 Fulton St., New York City.

PATENT ATTORNEYS

YOUR IDEA WANTED. PATENT YOUR INVENTION. I'll help you market it. Send for 4 free books, list of patent buyers, hundreds of ideas wanted, etc. Advice free. Patents advertised free. RICHARD B. OWEN, Patent Lawyer, 130 Owen Bldg., Washington D. C., or 2276 T Woolworth Bldg., New York.

INVENTIONS WANTED! Manufacturers constantly writing us for patents. List of inventions actually requested and book "How to Obtain a Patent" sent free. Send rough sketch for free report regarding patentability. Special assistance given our clients in selling patents. Write for details of interest to every inventor. Chandlee & Chandlee, Patent Attorneys, Est. 21 years. 551 7th St., Washington, D. C.

PATENTS—Without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D. C.

PATENTS ON EASY PAYMENTS—Send model or sketch for Free Search and Certified Registration of Your Invention for Your Protection. Free Book Tells What to Invent and How to Obtain a Patent on Easy Payments. C. C. Hines & Co., 593 Loan & Trust Bldg., Washington, D. C.

PHONOGRAPHS

BUILD YOUR OWN PHONOGRAPH or manufacture them for profit. Drawings, instructions, etc., Twenty-five Cents. Satisfaction guaranteed. Circular free. Associated Phonograph Co., Dept. E, Cincinnati.

TELEGRAPHY

TELEGRAPHY—both MORSE AND WIRELESS, also STATION AGENCY, taught quickly. TREMENDOUS DEMAND—much greater than supply—PERMANENT POSITIONS SECURED. BIG SALARIES — recently raised. IDEAL WORKING CONDITIONS—short hours, vacations with pay, sick and death benefits, etc.—prevailing. GREAT OPPORTUNITIES FOR ADVANCEMENT. WOMEN OPERATORS also greatly desired by Railways and Western Union. Tuition reasonable. Cheap living expenses—can be earned. Oldest and largest school—established 43 years. Endorsed by railway, Western Union and Marconi Telegraph Officials. Large illustrated catalogues free. Correspondence courses also. Write today. ENROLL IMMEDIATELY Dodge's Institute, Lone St., Valparaiso, Indiana.

100,000 MEN NEEDED IMMEDIATELY to serve as radio operators in Signal Corps, submarine chasers, battleplanes, and merchant marine. GRACELAND, a fully standardized and officially accredited junior college, offers TWO COURSES: EIGHTEEN WEEKS INTENSIVE TRAINING, and RADIO SUPPLEMENTARY COURSE with which other work can be taken in the regular college departments—collegiate, academy, shorthand, typewriting, stenotypy, conservatory, etc. Both courses lead to commercial operators license, first grade. Recognized by U. S. Government as a RADIO OPERATORS' TRAINING SCHOOL. GRADUATES GUARANTEED POSITIONS with commercial companies or government, as desired. Radio students participate in all college activities,—athletics, literary, glee club. MILITARY, etc. Extraordinary LOW TUITION AND EXPENSES; student self-help. Send to-day for free illustrated catalog. WIRELESS TELEGRAPHY DEPARTMENT, GRACELAND COLLEGE, Lamoni, Iowa.

WIRELESS

COILS—300 ¾" complete, $1 and postage. 800 ½"-no vibrators, 55c and postage. Exchanges considered. Alfred Dubs, 1534 Pitkin Ave., Brooklyn, N. Y.

WARNING! Do not be tempted to buy cheaper coils as you will eventually pay the difference. Our coils were constructed to jump a full ¾" spark, while others are really ⅜" coils but are strained to ¾" thereby breaking down secondaries. ¾" coils complete, $1.40; ¾" coils without vibrators, $1.00. 1½" Coils, cabinet style, complete, $3.50. All answered. Guaranteed. J. Eisgran, 1520 St. Marks Ave., Brooklyn, N. Y.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The *Very* people, the *Only* people, who could possibly have a use for your things read this journal. More than 75,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange columns only.

The rates are: *Five cents per word* (name and address to be counted). minimum space 3 lines. Count about 7 words to the line. *Remittance must accompany all orders.* No advertisement for less than 50c. accepted.

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the February issue should reach us not later than December 23d.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

OVER 90,000 PEOPLE READ THIS JOURNAL

BARGAINS—Hawkin's Electrical Guides, new, eight volumes, $6.75; high voltage telephone transmitter, 65c; good spark coil, 1", $1.50; ¼", 75c; Electro rheostat regulator, ten ohms, 35c; Experimenters, 1916-1917, $1. Postage Extra. Adolph Froehlke, Neenah, Wis.

SMITH MOTOR WHEEL—Good as new, all bearings, casing, etc., are in excellent condition. I will sell for $35 spot cash. Clyde M. Rogers, 1200 Bluemont, Manhattan, Kansas.

FOR SALE—Desk telephone, has been used, but is in firstclass order. Price, $3. C. R. Robbins, 107 E. Main St., Meriden, Conn.

FOR SALE—Electric Train, first-class condition. Arthur Gibbs, 449 Market, Portland, Ore.

WILL EXCHANGE—Wireless goods and telephones for cornet or twin mortocycle engine. Write for photographs. Sherman Applegate, Avon, New Jersey.

FOR SALE—Mignon RLC5 receiving cabinet, excellent condition, wave-length, 10,000 meters, $25 cash. Milton Ackerman, St. Johnsville, N. J.

MOTORCYCLE ENGINE—Thor 1913 model; 5 H.P., good condition; $20; has clutch on engine shaft. L. H. Murdock, 3315 Stettinius Ave., Hyde Park, Cincinnati, Ohio.

FOR SALE—Four-blade ceiling fan; one computing scales; write. Louis Elfers, 605 Grandview Ave., Muscatine, Iowa.

MUST SELL—Radio apparatus. Half price. Write now! WIRELESS, 102 Heath, Somerville, Mass.

BARGAIN—8 lbs. No. 37 S.C.C. Magnet Wire. Will sell for $18. Worth $30. Never used. D. P. Strand, 567 Lynn St., Malden, Mass.

FOR SALE—Gasoline hollow wire light, slant tank, pump, 20 ft. of hollow wire, all letters answered. The Boy Electrician, Darlington, Ind.

BARGAINS—Royal typewriters; four minute phonograph; printing outfit, motor, books, portable receiving set, 2X Meccano. Stamp brings full descriptions and prices articles wanted. Room 7, 119 N. Pennsylvania, Greensburg, Pa.

EXCHANGE—$30 wireless set for bicycle motor. Wm. Kronmeyer, Jr., Litchfield, Ill.

FOR SALE—An astronomical telescope that actually shows things—no toy—75 diameters. A sure enough find for $18, or have you a flexible transformer. Ask M. E. Everson about it. Neligh, Neb.

SELL—Two new Electron Relays, each $2.75; new Tigerman Detecto-Amplifier, cost $7, sell $3.50; "O" Crystaloi, $2; two new Lenzites, each $3. Everything unused. Brainerd Stratton, Oneida, N. Y.

FOR SALE—Four Meccano sets worth $12. First $8 takes them. Geo. Milne, 142 Totowa Rd., Paterson, N. J.

FOR SALE CHEAP—1 6 volt K & D motor No. 5, $5.50; 8 point Rheostat, for small motors, 50c; Reversing Switch, 50c; 3 Telephone Transmitters, each 75c; ½ lb. No. 36 Enamel covered wire, $1; Electric Whistle, 40c; "Solar" 6 volt 70 amp. Storage Battery, $7.50; 3-way Transformer, 6, 8, 14, 80c; 10 ohm Magnet, 80c; 80 ft. ⅛" square rubber, $2.50; 3¼x5½ Printing Frame, 20c; 1 stick of Selenium, 30c; ½ coil spring, new, 30c; Two 20 ohm Standard Relays, ea. $1.25. William J. Murdock, 322 South Main St., Clinton, Ind.

WANTED—All kinds of photography goods. Have some fine things to exchange. A. Hofman, 382 Cornelia St., Brooklyn, N. Y.

SACRIFICE—Magnificent Cyclopedia Applied Electricity, write enclosing stamp. Warnecke, Jr., 23 E. 88th, New York.

EXCHANGE OR SALE—Superior Phones, $4; E. I. Vario Selective Coupler, $4; 300 ft. 4 strand Antenium Wire, $2.25; Two 10½" Insulators, 60c; Four 5½" Insulators, 75c; Junior Fixed Condenser, 30c. Above articles never used. Also E. I. Commercial Detector, 75c. Have 25 Boy's books. Want, 110 volt motor, must be good condition, or cash. Write if interested. J. Raymond Stafford, 103 Fisher St., Marquette, Mich.

CYCLECAR material! 4 H.P. motorcycle engine, magneto and carburetor; steering gear complete; front and rear axles; 4 full eliptical springs; 2 foot levers; 4 wire spoked solid rubber tired wheels. Sacrifice, $30, R. R. CROWE, Box 126, Baraboo, Wis.

"WANT TO SWAP"?

Do you realize that these "Scientific Exchange Columns" are the World's most renowned "Swap" market? "THE ELECTRICAL EXPERIMENTER" prints 90,000 copies of this issue; that means that at least 180,000 readers see this page and probably a great many more. Our readers who advertise here seldom advertise the same thing twice—usually within five days after the issue is out the advertised article has been sold, or swapped. The many testimonials which we print here from time to time are ample proof of the almost miraculous pulling power of these columns.

Look around in your attic or workshop and you will find dozens of long forgotten articles, useless to you now, but very useful to someone else. At a ridiculously low cost you can either sell or swap such articles.

And remember this fact: The U. S. Postal Laws protect you. No one can "do" or cheat you. Of 3,495 "ads" published in these columns during the past five years, only twelve complaints were reported to us, and each and every one was adjusted to the full satisfaction of the complainant.

It matters not if you have old books or magazines, a kodak, electrical or chemical apparatus, scientific instruments, bicycles, typewriters, moving picture machines, air rifles, watches, structural toys, etc., etc. All these and countless others can be speedily disposed of here. Try it and be convinced.

329 Elm St., Penn Yan, N. Y.

Gentlemen:—I wish to tell you of the successful results I obtained from my ad in the "E. E." Before the publication date I received an inquiry and ever since they have been "pouring" in at the rate of several each day.

To date, I have received sixty-three inquiries and have disposed of most of articles advertised.

Inquiries have come from as far South as Florida, West from Colorado and several from Canada.

Thanking you for your promptness in inserting my ad, and wishing a long and prosperous "life" to the ELECTRICAL EXPERIMENTER, I remain,

Yours truly,

Lester Chisholm.

FOR SALE—M-M Motorcycle, 8 H.P. twin with clutch and good tires, in best of running order, $50. Also Indian twin 3 speed electric equipped. New tires, speedometer and tandem price $150. Reason for selling, in draft. Isaac Gossard, Hagerstown, Md. R1.

AMATEURS! EXPERIMENTERS! Do you want to experiment with submarine signalling? I have super-sensitive microphone buttons previously used for sub-sea experiments, only $2 a unit. Also one Paterson battery holder, new $12, sell for $4. One fine Western Electric testing magneto in box, $8, the thing for experimental laboratory. Samuel Cohen, 1936 Pitkin Avenue, Brooklyn, N. Y.

First check for $10 takes motorcycle engine complete. Duffield, 149 Rhodes Ave., Akron, Ohio.

WANT—½ to 1 H.P. 500 volt motor or generator, Weston or Keystone portable ammeter 0-50 amperes, voltmeter 0-150 volts. Will buy for cash or exchange for radio apparatus. Have an excellent Keystone milliampere meter; fine for research work. Samuel Cohen, 1936 Pitkin Ave., Brooklyn, N. Y.

$200 TELEFUNKEN, 1 to 5 K.W. radio a.c. transformer, must sacrifice for $37.50. $100 new typewriter, $50. DeForest oscillion ($60), new, sell $40. H. T. battery $5. $28 General Radio Wavemeter, $15. $10 Hotwire ammeter, $5. Variable Condenser, $2. 1/6 H.P. A.C. motor, $12. 110 v. ammeter, $5. 150 voltmeter, $5. Want two $50 Columbia Graphonolas or Sonora or Pathé phonographs. Apt. 51, 55 Hicks St., Brooklyn, N. Y.

EXCHANGE—$25 Elgin wristwatch. $40 Cameo ring $25 man's watch. New. Want: Drums, traps, Colt, wireless, bicycle or what have you? F. J. Elwell, General Delivery, Syracuse, N. Y.

FOR SALE—Richardson direct reading slide rule, leather case and instructions, $3 prepaid. Edw. C. Schurch, 314 W. Babcock St., Bozeman, Mont.

Have $20 telescope, power 40, in good condition. Want round DeForest Audion Bulb, 2 Turney 2 cone plate .001.000035 variables. Will sell for $17.50. Ralph Wood, Dewey Ave., Portsmouth, Ohio.

Two 6x10 hand printing presses $12 and $18; also type, rules, etc. Have a lot of mail-order literature $5. Write your wants. Alderman, 17 Plymouth St., New Haven, Conn.

FOR SALE—I. C. S. Auto Running Course 2 vol. in excellent condition. First $10 takes it. Also $10 Premo Camera for $5. L. Barger, Peekskill, N. Y.

EXCHANGE—$40 Electric vacuum cleaner best condition. Want, motor wheel or gasoline engine or make offer. Charles Harding, 2 Rawson Ave., Newburyport, Mass.

FOR SALE CHEAP—Brandes 2000 ohm phones; Amco loading coil; Galena Detector; 1000 ohm Receiver; 800 M. Coupler; 4 K.W. Aerial Switch; Universal Motor; 1 K.W. Oscillation transformer; K.B. Preventer; Electrolytic Interrupter. Also other supplies, as switches and keys. Make me an offer. James Green, Jr., Orangeburg, S. C.

BARGAIN—¾ K. W. old type Thordarson Transformer, 25 Cycle, 110 V.A.C. Perfect condition. $10. Rife Baxtresser, 65 Seneca St., Buffalo, N. Y.

WANTED—Volume 1 (year 1913) and Nos. 2 and 3 of Volume 3 (year 1915) of "Proceedings of the Institute of Radio Engineers". Write, stating price, to Corporal G. Israel, 8° Genie TSF La Couronne (Charente), France.

WANTED—Copy of book "Michael Faraday, His Life and Work" by Sylvanus Thompson. Also an ohmeter of the Roller-Smith type or a Wheatstone bridge; must be in first-class condition, and include galvanometer. H. W. Secor, c/o ELECTRICAL EXPERIMENTER, 233 Fulton St., New York City.